SCIENTIFIC AMERICAN

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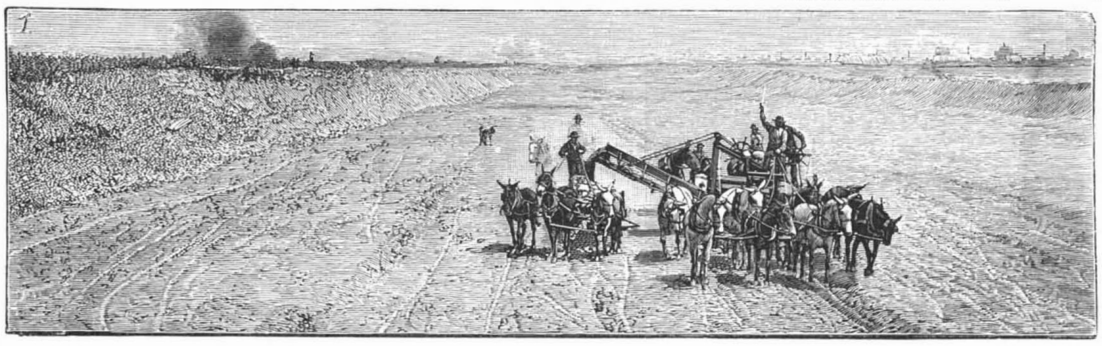

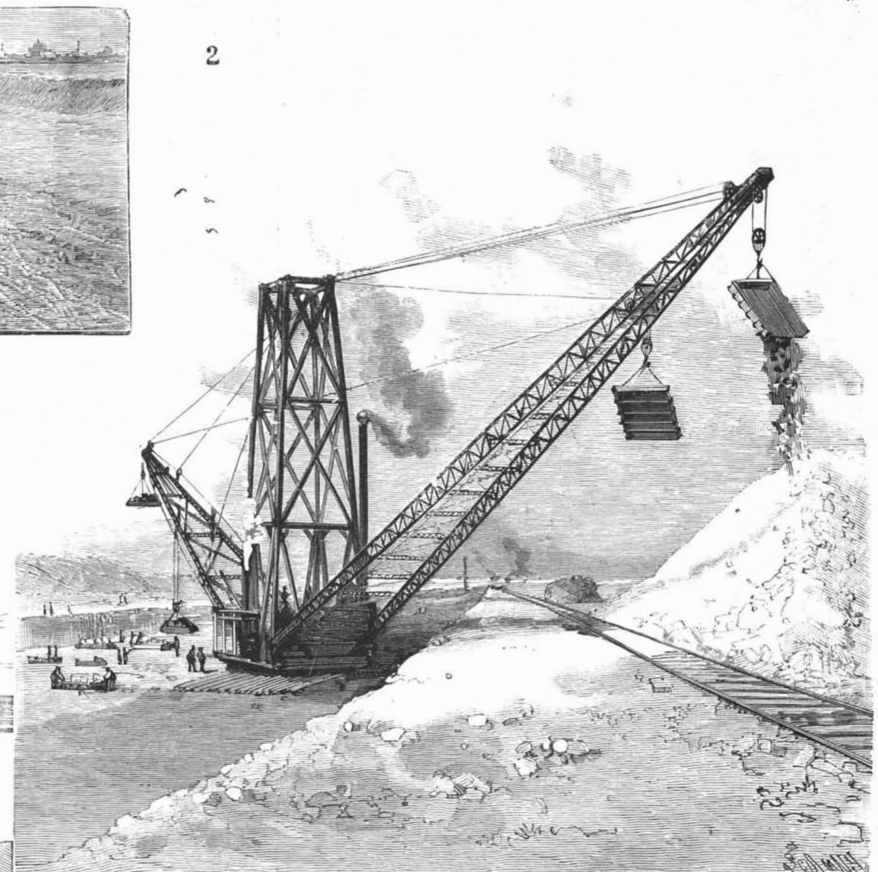

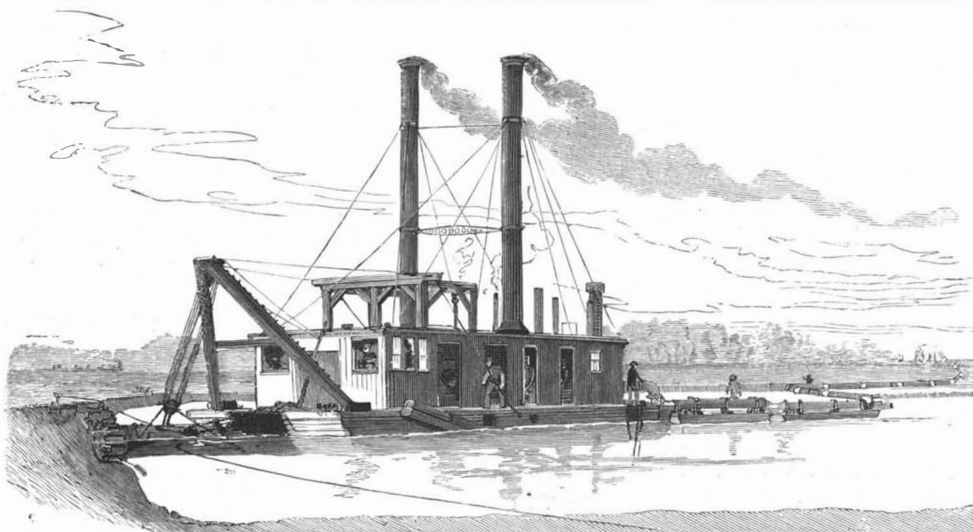

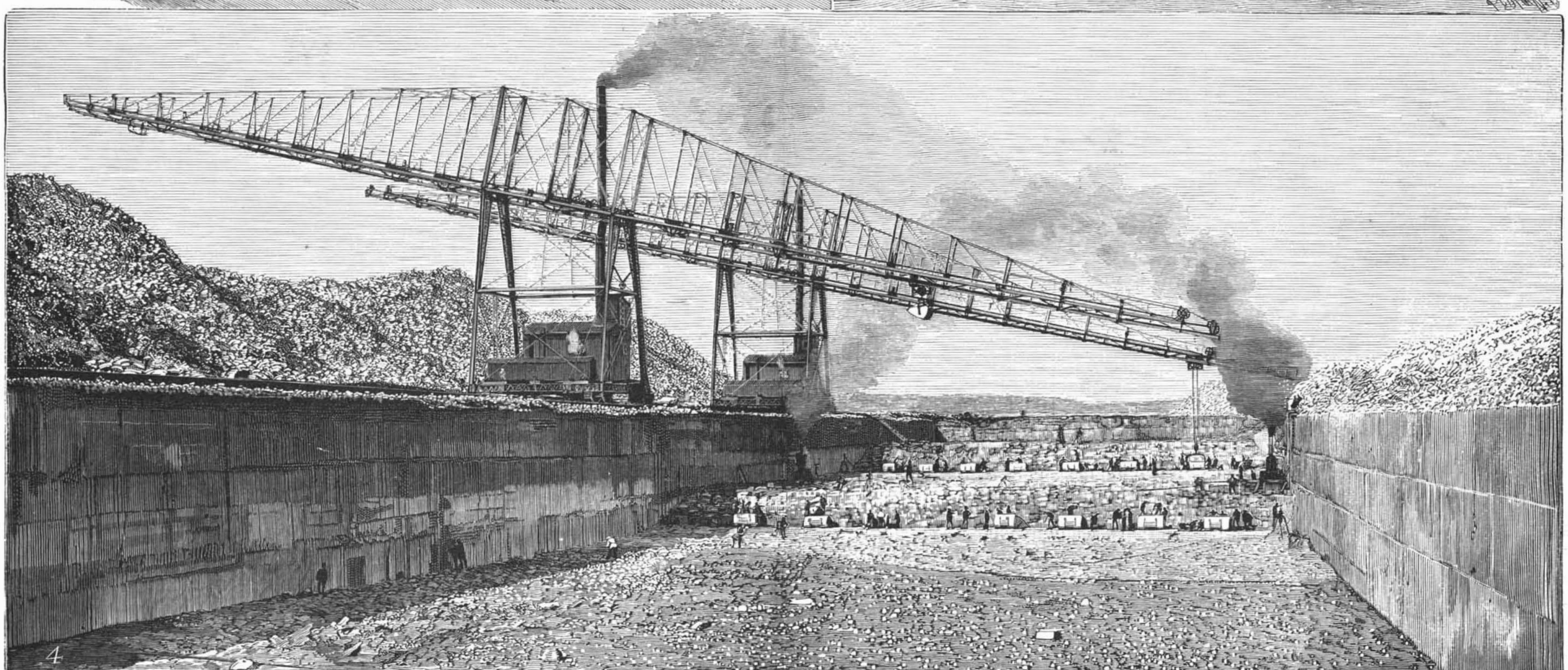

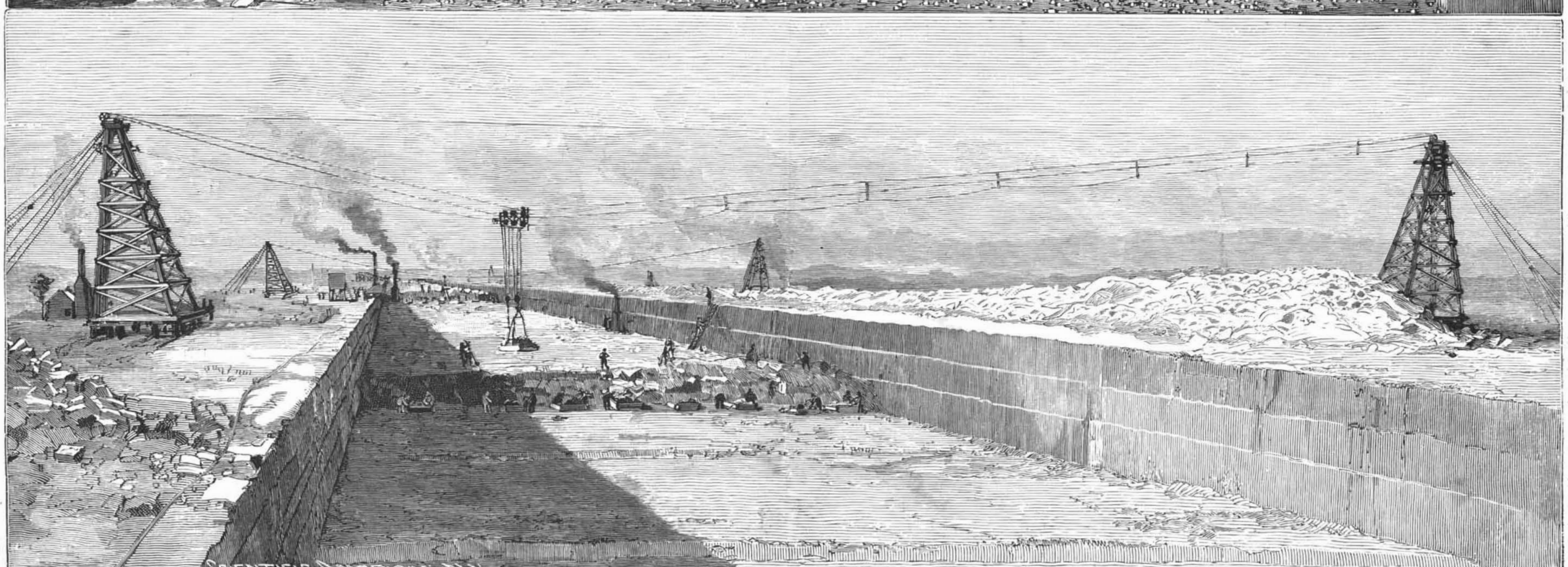

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THE GREAT CHICAGO CANAL.—[See page 247.]

Scientific American.

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NEW YORK, SATURDAY, OCTOBER 20, 1894.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 981.

For the Week Ending October 20, 1894.

Price 10 cents. For sale by all newsdealers.

ACOUSTIC PROPERTIES AND RESONANCE OF BUILDINGS.

The pleasurable enjoyment of a public discourse, a debate or a concert may be largely interfered with or destroyed by the acoustic or resonant conditions of a public hall—not that the entire audience is so afflicted, but almost every public hall not expressly arranged or dressed for the purpose has some local points or nodes in which the direct and reflected pulsations of sound meet at unequal times, arising from the difference in distance traversed by their direct and reflected courses.

The laws in regard to the reflection and refraction of sound are the same as for light, and the nodes and acoustic curves of condensation of vibratory effect may be as graphically laid down for sound as for light. They are practically illustrated in large whispering galleries and domes, such as the whispering gallery of St. Paul's, London, the sculpture dome in the Capitol at Washington, and to a limited extent in many large public halls and domes. A most remarkable building for excessive acoustic and resonant properties is the Mormon beehive temple, Salt Lake City, having a capacity for 14,000 people; the drop of a pin on a plate at one end can be distinctly heard at the other, and the resonance or reverberation from a speaker is so intense and confusing that leafy branches of trees have been suspended from the ceiling to diminish it.

An example of a lecture hall free from acoustic echo is found in the Smithsonian Institution in Washington, which was originally designed with the purpose in view of perfect freedom from acoustic defect.

To find a remedy for acoustic echo and resonance in halls and lecture rooms already built, and to avoid these properties in new constructions, is a much desired need with architects and builders, as well as with lecturers and hearers. It is conceded by those who have examined the details of the reflective and nodal points in the transmission of sound, and its similarity to the reflective and refractive properties of light, that if the reflective properties of walls and ceiling can be neutralized without destroying or materially interfering with the architectural harmony of large public rooms, the point most desired for an oratorical or a music room will be attained.

In an architectural point of view, the breaking up of long and high walls and ceilings into a system of panel work is a move in the right direction, but a more severe treatment than plain surfaces is needed to make a success.

Plain, hard-finished walls and ceiling are powerful reflectors of sound, and when a speaker stands at a nodal point, the reflected sound vibrations are repeated many times, resulting in a confusing resonance.

Not only do the walls and ceiling contribute to a repetition of sound waves, but uneven temperature and the presence of gases in large halls contribute to the confusion of the voice and to destroy the purity of musical tones by the unequal degree of sound refraction, from the varying densities of different portions of the air; hence a plea, other than hygienic, for uniform temperature and ventilation, without strong draughts, in large halls.

The sound of a syllable moves through the normal atmosphere at mean temperature at the rate of 1110 feet per second; so that a hearer in a node of reflected sound, near to and listening to a speaker uttering five syllables per second, with a reflecting wall at a distance of 112 feet, will hear the echo of one syllable exactly overlapping the next direct syllable; thus making a complete resonance, most annoying to healthy ears, and a pandemonium to the nervous.

A voice uttering syllables at the rate of three per second will have a return of one syllable to meet the next from a wall at 186 feet distance, and a return exactly between syllables from a wall 93 feet distant, and overlapping in a confusing degree at less distances.

If the rostrum is at the end center of an oblong room, the resonance will be cumulative, and return to the speaker with increased force, while, if placed at the center of a side, the resonance is dispersive, and does not strongly focalize on the speaker.

Corner rostrums in square rooms are favorable to a dispersive resonance; but wherever it is convenient to place a rostrum, or for any position of a speaker in a debating hall, a proper treatment of the walls and ceiling will largely if not totally neutralize acoustic resonance.

Smooth hard-finished and continuous walls in rooms designed for lectures and music should be avoided in new structures and so changed in rooms already finished as to produce the least acoustic resonance with the least cost in the required work.

The system of stringing wires across a room below the ceiling has been tried in England and found expensive and uncouth, and in an architectural point of view not to be tolerated. Draperies for walls already finished are a most ready means for temporary relief. The draping of windows with suitable curtains and the intervening walls with festoons of bunting will almost relieve the reverberation; but the accumulation of dust on draperies and consequent depreciation of the freshness and beauty of a public room is a bar to their permanent use. Wherever it is found expedient to drape walls for temporary use only, those in front of the speaker and only partially at the sides need be draped. A rear hard-finished wall is an advantage, for its nearness increases the strength of the voice by reflection in the right direction, and without materially overlapping the vibrations. The acoustic condition of rooms now in use having smooth-finished walls and ceilings can be much improved if not entirely corrected by the application of roughfaced or embossed wall paper, of which the Anaglypta and Lincrusta-Walton are types. For future construction the rough plastering now much in vogue is recommended. The stipple plaster with deep-figured dado borders has proved a most valuable agent in deafening the acoustic resonance of public rooms.

The Real Estate Exchange in New York is an excellent example of a non-resonant room by this treatment.

Explosion of Twenty-seven Steam Boilers.

At Shamokin, Pa., on Oct. 11, twenty-seven of a nest of thirty-six boilers at the Henry Clay Colliery exploded about 7:30 o'clock in the morning, completely destroying the boiler house, killing five men, seriously injuring two, and slightly injuring four.

Without warning the last boiler on the west side of the nest went up, and it was followed by the others in rapid succession. The workmen were knocked in every direction, and what had been a strong corrugated iron building disappeared as if by magic. All that remained was a mass of bricks and timbers, pieces of twisted pipe, and battered boiler iron.

The nine remaining boilers were so injured that they can never be used. Pieces of heavy steel were carried hundreds of yards, while a half of a boiler was found over a quarter of a mile away up the mountain. The report was heard for miles.

The explosion occurred just after the colliery had started work for the day. It was a very cold morning, and the men who were killed and injured were standing around the boilers getting warm.

One cause given for the explosion is that the boilers had become weakened by the mine water that was used during the long drought in the summer. Lime was used to neutralize the acids in the mine water, but the boilers are said to be quickly eaten away by this water.

The colliery is operated by the Philadelphia and Reading Coal and Iron Company. The pecuniary loss is $100,000. Sixteen hundred men and boys are thrown out of employment. The shaft pay roll amounted to $40,000 per month. It will take six weeks before the plant will be able to resume.

Science.

A lucid statement concerning the exact nature of scientific verity has been given to the public by the president of the American Association for the Advancement of Science, Dr. Daniel G. Brinton. Dr. Brinton is a citizen whom Philadelphia delights to honor; he is perhaps without a rival among all the American scientists of to-day as a scholar of versatile culture. Speaking as one with authority, he declares:

"The one test of scientific truth is that it shall bear unlimited and untrammeled investigation. It must be not only verified, but always verifiable. It welcomes every trial; it recoils from no criticism, higher or lower; from no analysis, from no skepticism. It challenges them all. It asks no aid from faith; it appeals to no authority; it relies on the dictum of no master. The evidence, and the only evidence, to which it appeals or which it admits is that which it is in the power of every one to judge, that which is furnished directly by the senses. It deals with the actual world about us, its objective realities and present activities. It does not relegate the inquirer to dusty precedents or the mouldy maxims of commentators. The only conditions that it enjoins are that the imperfections of the senses shall be corrected as far as possible, and that their observations shall be interpreted by the laws of logical induction."

This dictum should be remembered as the sworn affidavit of a society which numbers over 2,000 scientists among its adherents and embraces all the prominent lines of scientific research; a society which presents in its forty-two volumes of transactions an abstract and epitome of the scientific work of the United States for nearly half a century. This definition really defines. It makes an exact survey of the farthest boundaries and utmost limits of the domain of science. From this map of its scope, the precise value of its discoveries can be determined.—Philadelphia Record.

Paper Making Materials.

There are many patents relating to the manufacture of paper. Some of the patents provide for the making of paper from the leaves of trees, from hop plants, bean stalks, pea vines; from the trunks and stems of Indian corn and every variety of grain; from moss, hay and more than one hundred kinds of grasses; from straw and cocoanut fiber; from fresh water weeds and sea weeds; from sawdust, shavings and asbestos.

Days in Rome.

In connection with this place, where the old Romans made holiday, I may speak of the baths of Caracalla, where, even more than in the Coliseum, one gets a sense of the luxurious pleasure-loving life that was led under the emperors. Passing through the arch of Constantine, which stands close to the Coliseum, we are in a quarter of an hour at the entrance to this ruin. Parts of the outer walls are standing, but vineyards are growing on a considerable portion of the land they once inclosed, and a stranger might drive by without realizing that he was passing one of the most interesting places to be seen. It is hard, even upon the ground, to realize how grand a club house this was. It covered a square mile. The mosaic floors of some of the rooms are well preserved and are in pretty patterns. The partition walls are destroyed, but the ground plan has all been made out and can be easily traced. We walk around in the great swimming baths where the water could stand six feet deep; we can see arrangements for heating the water for the tepidarium and caldarium.

The great building was double, the two parts being alike. Sixteen hundred bathers could be accommodated at once. Besides the bath rooms, there were gymnasia and halls for other amusements. In what is supposed was the grand parlor, the famous Farnese Bull and statues of Hercules and Venus, now in the Naples museum, were found; in fact, no less than 200 pieces of statuary were taken away when the place was excavated. The floor of the sitting room was alabaster; the lower part of the walls was covered with porphyry and above was pink marble. There was a race course included among the attractions. Fragments of columns of granite, pieces of friezes and broken statues are standing against the broken walls. In many places the mosaic floors have sunken under the weight of the mass which rested upon them. The building was begun by Caracalla about 220, and it was only the fourth century when it was despoiled of some of the marbles and statues to ornament churches, and some were burned for lime. The steps of St. Peter's church are made of columns taken from here and split lengthwise. Adjoining this great public bath house were elegant private bath houses, of which but slight traces are in sight, but their location can be made out.

When the work of excavation began here, vineyards were growing all over the ruin.

The Forum is the part of Rome where, above all others, the traveler who knows anything of ancient history expects to feel that he is on more or less familiar ground. Under the best conditions he needs to summon all the resources of his memory and all the power of his imagination in the study of the bewildering place.

It is natural to begin the survey at the foot of the Capitoline. Here, in earliest times, there was a marsh extending to the Palatine, and it was to drain it that the famous sewer, the Cloaca Maxima, was built, probably under the fifth king, Tarquin. A sewer large enough for a load of hay to be driven through, with travertine walls laid without mortar, that, without being rebuilt, is still carrying drainage into the Tiber, surely deserves frequent mention.

This valley was the site of the Forum Boarium or cattle market, and the Comitium, and to the east and north were afterward the forums of the emperors. There were in fact, in the time of Rome's glory, eleven forums, all communicating with each other. It is, as I have said, bewildering to stand in this place, which was the center of life during the republic and the empire. The realization of a far distant past comes over one with overpowering force; the traces of power and glory are so nearly wiped out that we know they must have belonged to a remote time. What do we see?

Eight granite pillars are left to represent the Temple of Saturn, the oldest temple, built 400 B. C. This was used as a treasury; the story is that the lightning once struck it, and the gold stored there melted and ran in a stream into the Forum. Beside this temple passed the Via Sacra, upon which the tufa blocks of the old pavement still remain. Over it rises the large arch of Septimius Severus, raised 203 A. D. The bas-reliefs upon it, representing the siege and taking of Babylon, the passage of the Tigris and Euphrates, and other scenes in the career of the emperor, are worn and were at their best not fine works of art. This monument was used as a fortress in the middle ages; was partly buried, and was not uncovered until this century. Standing as it does at the foot of the hill, with high modern buildings above it, it is not an imposing object. Close to it on the right are the remains of an old stone rostrum, from which Cicero made his second speech against Catiline. It is but a few steps to the last monument of antiquity, the column of Phocas, upon which once stood the golden statue of the Byzantine usurper. On our right was the great Basilica of Julia, begun by Julius Cæsar and finished by Augustus. Low brick posts mark the places where the columns once stood; but they were used centuries ago for other buildings. The principal branch of the Cloaca Maxima runs right along the eastern end of the foundation of this basilica. We are now on the part of the Forum associated with Julius Cæsar. It is but a few steps to the new rostrum which he built. Here Mark Antony delivered the oration over his dead body, and a pile was improvised and the body was burned. There is little left of the rostrum, and virtually nothing of the temple, afterward erected over the place by Augustus in honor of his uncle, and as a resting place for his ashes. We pass now over the foundation of the Arch of Augustus, to look at a bit of the mosaic floor of the Temple of Castor and Pollux, and the three marble columns, considered among the most beautiful that have resisted the attacks of time.

We are now near the circular blocks indicating where stood the Temple of Vesta and the Palace of the Vestal Virgins. It was on or near this site that Numa Pompilius founded the first Temple of Vesta, when the sacred fire was brought from the shrine at Alba, and he ordered that four virgins be consecrated to the service of the goddess.

The date of the construction of these buildings is somewhat doubtful, but the plan has been carefully worked out. Pedestals with such names as Cœlia Claudiana, Terentia Flavola, and Flavia Publicia were found among the ruins. The inscriptions show that they once bore statues of the vestals, erected by friends or relatives who had obtained favors by their intercession. It is only ten years since excavations on this spot were made. The uncovering of the Forum was begun by Pope Pius IX., and the present government has continued the work.

The three colossal arches of the basilica of Constantine are in the distance as we go toward the Forum of Trajan. This was the model of the basilica churches, of which so many were afterward built in Rome. St. Peter's is so far a copy of it as to have its nave of the same size.

Northeast of the old Forum were the forums of the emperors. They were all intended to show the wealth and splendor and to celebrate the victories of their founders, rather than for public assemblies, though the principal edifice in each of them was a temple. The Forum of Trajan is the most interesting one. The four rows of broken columns of Egyptian granite set up in it are to show the site of the Basilica Ulpia. The main entrance was through a triumphal arch. His column, so familiar from pictures, is, I suppose, the most interesting of the many columns in Rome. When Trajan began the great work of joining the forums of the old city with the Champ de Mars, by making another, his architect told him that the Quirinal and the Capitoline hills would have to be cut down to carry out his plans. Trajan's reply was that his column, then, must be as high as these hills and as high as the Tarpeian rock, or 138 feet, and so it was built.

It consists of 24 blocks of marble, which are now dark gray. There are 2,500 human figures upon it, besides horses, machines, etc. The top was originally surmounted by an imperial statue of Trajan holding in his hand a gold globe. In this globe, it is said, his ashes were placed. But in 1587 Sixtus V. put a statue of St. Peter on top. As early as the tenth century this forum was in ruins, and churches were built among the columns. At one time no less than fifty houses stood upon its site. The French government, in 1812 and 1814, demolished many of these buildings, and began the work of bringing Trajan's plan once more to light. It is to-day a most striking commentary upon the transitoriness of all human work which is put into material form.

In this unsatisfactory survey of the forums I have not attempted even to name the churches which stand partly or entirely upon the ruins of the pagan temples. Each has its own interesting history; each suggests the conquest of Christianity over heathenism; each leads one's thoughts from its own walls to the arena of the Coliseum, where, we read, the early Christians faced the lions so calmly that sometimes the beasts did not harm them, and because they would not do it, men put them to death. A. D.

Rome, 1894.

A Bullet Proof Shield.

The Duke of Cambridge lately visited the Cyclops Works of Messrs. Charles Cammell & Company, Sheffield, and witnessed the testing of a bullet proof shield, manufactured by that firm, which was invented by Captain Boynton. The shield is simple in construction. It takes the form of a plate of specially prepared chrome steel, with a slot in the top for the soldier's rifle. The weight is less than one-half that of a life guardsman's cuirass, and the material has such powers of resistance that it is absolutely proof against the service bullet propelled by cordite through a Lee-Metford barrel at 30 yards distance. A bullet which would pass completely through an oak plank 30 inches thick is powerless to do more than make a slight indentation on Captain Boynton's plate, which is only three-sixteenths of an inch thick. Mr. Tucker, R.E., fired five shots at one plate from a Lee-Metford rifle, and at the request of the duke placed his shots as nearly as possible in the same spot. This extreme test was also withstood by the plate. There was no indication of anything like perforation. Each bullet struck the shield with more than a foot-ton of energy. Before leaving, his royal highness expressed his satisfaction with the result of the test, inasmuch as not the slightest damage appeared to have been done to the shield.

Valuable Woods.

Many of the finest woods in existence are yet unknown, or only slightly known, to the manufacturers of wood in the civilized world. The woods of Central and South America are, perhaps, the most remarkable as well as the least known. In the yet untouched forests of this continent are many woods far finer than any of those now in use. These woods range from pure white to jet black in color, and many of them are most beautifully marked and veined. Some of them are so hard that they turn the edges of axes, chisels and other tools, while the band saw cuts them only slowly. In the Columbian Exposition there were many displays of little known woods, and the finest of them were those from Argentine Republic, Brazil and other South American countries. Some of these southern woods yielded to the teeth of the band saw, not the ordinary sawdust, but fine powder, fine as the finest flour, so hard were the woods. Some of them burnt but slowly. Others possess qualities that keep them free from insects. Some of them seem to be practically indestructible by air and water. All along the eastern slopes of the Andes, up to the snow line on those great elevations, throughout all the great river valleys, and in some of the wide areas of level country in South America are great forests of fine woods that are specially fit for the finest cabinet and furniture work, and also for shipbuilding, carpentry and other industrial arts in which wood is the "raw material." These great forests are now an unknown quantity in the commercial world, but they will come rapidly into the knowledge of men and into industrial use when once the railroad has reached them. Before many years, it is safe to predict, the South American and Central American republics will be threaded by railroads, and then those wonderful woods will be drawn upon to supply the demand for new and fine woods in all the civilized countries.—The Lumber World.

Long Passenger Trains.

In a recent issue of the Kansas City Journal it was recorded that the Kansas City, Fort Scott & Memphis R.R. had the credit of hauling the longest train of loaded passenger coaches ever drawn in the world. It was composed of twenty-three coaches, which held an average of one hundred passengers each, and was run out of Kansas City to Merriam Park, carrying the colored school children, who took a day's outing at that resort. Last year the Alton took a train of twenty-one coaches into Chicago and claimed the record on big passenger trains.

The Alton record was beaten on May 7, 1894, by the Jacksonville, St. Augustine and Indian River Railway, which ran an excursion train, consisting of twenty-two crowded coaches, from Jacksonville to St. Augustine, a distance of 38 miles, in 1 hour and 15 minutes, three minutes of which were consumed in backing out of the Jacksonville yards and six minutes in taking wood and water en route. The actual running time, therefore, was one hour and six minutes.

On Sunday, Aug. 19, 1894, however, the same line of railway actually beat the record of the Memphis route and secured the world's record for big passenger trains. The regular passenger train from Jacksonville at 8:50 that morning consisted of twenty-five loaded passenger coaches and one baggege car, besides the Schenectady locomotive, which drew the train from South Jacksonville to St. Augustine without assistance. There were about 1,500 passengers on board, and remarkably good time was made. The occasion which called out this crowd was an encampment of a portion of the Florida State troops in the ancient city, and but for some previous agitation there against Sunday excursions and military parades, it is probable that fully thirty cars would have been required to handle the business.

The New Cunard Ships.

Recent voyages by the two new Cunard steamers Campania and Lucania, plying between New York and Liverpool, establish their records as the fastest vessels of their class now afloat. The mean speed of the Campania has been 21·5 knots per hour and the Lucania 21·65 knots. The Lucania has made 555 miles in 24 hours, being the highest known speed for that period, and equivalent to 22⅓ knots per hour. The round voyage of 5.598 miles has been made by the Campania in 10 days 20 hours 14 minutes. These are remarkable performances, and show how thoroughly strong and excellent the vessels must be in hulls and machinery. These ships are the greatest speeders, and, we may add, the greatest coal consumers of any of the Atlantic fleet.

AN IMPROVED CAR FENDER.

This fender is of inexpensive yet substantial construction, and may be quickly attached to or removed from a car, or conveniently folded up against the dashboard, as shown in the small figure, when not required for use. It has been patented by Mr. Herman B. Ogden, of No. 204 Carroll Street, Brooklyn, N. Y. It consists of two frames hinged together and covered with wire netting, the upper frame having hooks adapted to engage the draught rings on the end of the car formerly used for tow horses, and being supported at the right inclination by chains extending to eyes

OGDEN'S CAR FENDER.

near the top of the dashboard on either side. The frames have abutting meeting rails or cross bars which prevent the outer frame from swinging too low or sagging. Depending from the sides of the lower frame are arms which carry a roller just above the roadbed, which it strikes when unusual pressure comes on the fender, or with the rocking of the car. The fender is so constructed as to come in contact with the roadbed without injury. A forward extension of the fender projects in front of the roller, the side arms of this extension being held in keepers on the side bars of the lower frame. When one is run down by the car, the extension is designed to trip up and throw the person uninjured into the netting, the weight of the falling body then causing the roller to come into contact with the roadbed and furnish a firm support for the fender.

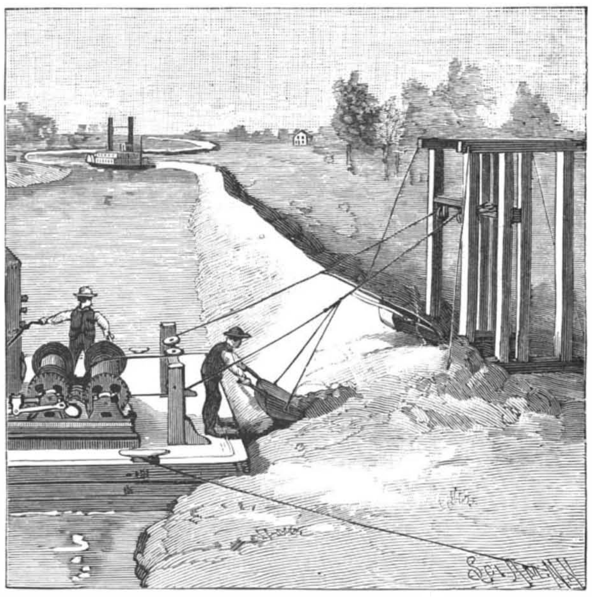
The motor man cannot fail to use the fender at night, as the headlight cannot be put on the dashboard till the fender is down in place. The fender takes up no room when the cars are stored in the sheds, being then folded up out of the way.

THE SPEED OF VESSELS. — Lloyd's latest publication shows that out of the 13,000 steamers recorded in the "Registry," only 45 vessels have a speed of 19 knots and above, and of this number 18 are credited with a speed of 20 knots or over. Of the former number 25, or more than half, were built on the Clyde, while of the 20 knot boats 12 are Clyde built, 3 have been constructed in other parts of the kingdom, leaving 3 for abroad. Foreign builders constructed a dozen of the 45 of 19 knots and over, but, on the other hand, foreigners own 20 of these 45. The remarkable fact is that of the 20 knot boats 9 are paddle steamers and 9 twin screw, none being single screw. For high speeds, therefore, the single screw is of the past; and it might also be said that the side paddles are giving way to twin screw propulsion. The difficulty hitherto has been the draught of water available, the paddle requiring less water in which to work than the screw propeller, which must be completely immersed. But when it is remembered that in action the screw propeller is similar to a wheel revolving, it will be understood that by increasing the revolutions it is possible to reduce the diameter and still get the same speed. A few years ago 90 revolutions was high; now 200 is exceeded in several vessels and 400 has been reached in torpedo craft.

Another circumstance which makes the screw preferable is that it has, as a rule, only half the slip of the side paddles. Slip is used in the same sense as in the case of a locomotive wheel. The slip of a 20 knot paddle steamer is 26 to 30 per cent the forward motion, against 13 to 15 per cent in a twin screw steamer. Again, the proportion of weight of machinery to the total weight of the steamer is less in a screw steamer, since more has been done to lighten the parts than with the paddle engine. In the latter 8⅜ I. H. P. has been got per ton weight, in the former 11 I. H. P. per ton. In a paddle steamer 45 per cent of the total weight goes in engines; in a screw steamer, where more provision is made for cargo, only 31 per cent of the total is for machinery.—Glasgow Herald.

AN EXCAVATOR FOR USE ON RIVER BANKS, ETC.

The illustration represents an apparatus of simple construction designed to be especially effective in forming embankments along rivers, etc. It has been patented by Mr. John P. Griffin, of Cincinnati, Ohio (southeast corner of Sixth and Smith Streets). The driving engine, on any suitable flatboat, is connected by gears and readily operated clutches with two drums on which wind the ends of a rope extending outward over pulleys held in a suitable framework on the stern of the boat, the arrangement being such that as the rope is wound upon one drum it is unwound from the other. The rope extends from the boat up the embankment and passes over pulleys in a suitable framework held in place by anchor ropes, the framework being of such description that it may be readily shifted to new positions along the embankment. On the up and down runs of the rope are attached branch ropes connected with shovels or scrapers, and when the engine is running, the operator, by means of shifting devices which throw one drum out of gear and the other into gear, causes one of the scrapers to be drawn up the embankment and automatically dumped, while the other scraper is being returned to be filled. Thus the scrapers travel in opposite directions, and are alternately filled and emptied and returned to their place of starting.



GRIFFIN'S EXCAVATOR.

SWAMP MUSIC.

We have already made known to our readers the tentatives that have been made to translate the song of certain birds by musical characters, but such attempts have not been confined solely to the warbling of the songsters that people our groves and fields in the spring. A few observers, from the highest antiquity, have extended these interesting remarks to the original voice of frogs and toads, and, in general, of all the animals that can be arranged under the denomination of inhabitants of the swamps.

Such observations, at their inception, belonged rather to the domain of fancy, and it is not until the second half of the last century that we find notes upon this subject that have an essentially scientific character. Our contemporary Le Naturaliste has recently given an account of these, from which we extract the following passages:

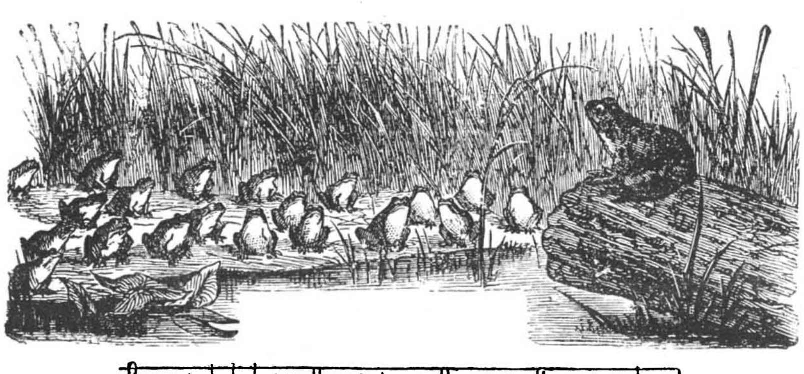
It was the Bavarian scientist De Rosenhoff who was the first to furnish us with valuable information in regard to this interesting question. This writer gives a description, as detailed as it is circumstantial, of the voice of the frog and the noises that it makes, but does not occupy himself with the anatomical and physiological side of the question. The first anatomical and physiological explanation of the vocal apparatus of the animals under consideration was given by a very eminent French scientist, Professor Duges, of the University of Montpellier. On another hand, several eminent naturalists, such as Ekker, Robert Widersheim, Franz Leidig, and Hermann Landois, having become interested in the scientific work of Duges, endeavored to give their respective interpretations of the complicated, as well as interesting, operation of the vocal apparatus of the inhabitants of the swamps. It is to be remarked, moreover, that the physiological explanations of Muller and Landois relative to the constituent parts of the vocal apparatus of frogs and toads are of the highest interest. The others relate only to the anatomical side of the question. If we observe the green frog (Rana esculenta) in the act of croaking, we shall in the first place see two pouches inflating at the sides of the cheeks, and disappearing as soon as the frog begins to "sing." It is therefore useless to remark that the croaking of the frog is connected with the two membraneous pouches just mentioned. But this is only a secondary relation, as has already been shown by Aristotle, who tells us that "the frog emits sounds through its throat."

What, then, is the role of these famous membraneous pouches? They are probably resonators designed to re-enforce the sound, as is done, for example, by the hollow body of a violin. The fact must not be lost sight of that the frog croaks with its mouth closed in producing sounds with the same quantity of air and in causing a continuous circulation of the air of the lungs in the inflated pouches. Hence by reason of the elasticity of the walls of the latter, the air returns to the lungs by way of the larynx. As for the small quantity of air that escapes through the orifices of the nose, that is very quickly compensated for during the short pauses in which the frog begins to respire strongly. It must not be thought that the organism can suffer from so feeble an exchange of air, and this is why: In the first place, in the frog there is a very slight exchange of materials as compared with warm-blooded animals, and, on another hand, respiration is effected likewise through its moist and very delicate skin, which is provided with numerous veins and arteries. Thus, the air, feebly exchanged during the frog's croaking, is driven into the buccal cavity, while the animal's mouth is closed, through the contraction of the muscles of the sides of the body. As the vocal cords approach each other at this moment, the air passing between them separates them, a vibration is produced and a sound is made.

It is to be remarked that the production of the sound is effected by the same process, not only in the inhabitants of our ponds and marshes, but also in all their kin.

A few digressions, of small importance, as for the rest, are to be noted. Thus, in the spotted frog, the membraneous pouches are but slightly developed and are situated near the median line, so as to constitute but a single one.

Now that we are acquainted with the vocal apparatus of these animals, the question is to know in what measure they have interested musicians and artists. As regards this, it is to be remarked that the inhabitants of the swamps have been thoroughly neglected by modern artists, and to such an extent



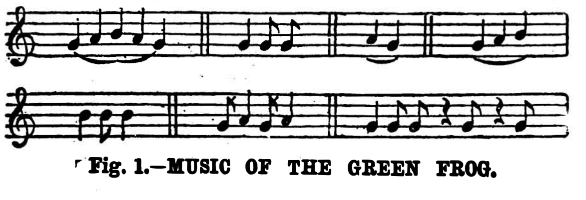


Fig. 1.—MUSIC OF THE GREEN FROG.

Fig. 3.—MUSIC OF THE SPOTTED FROG.

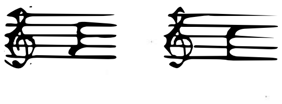
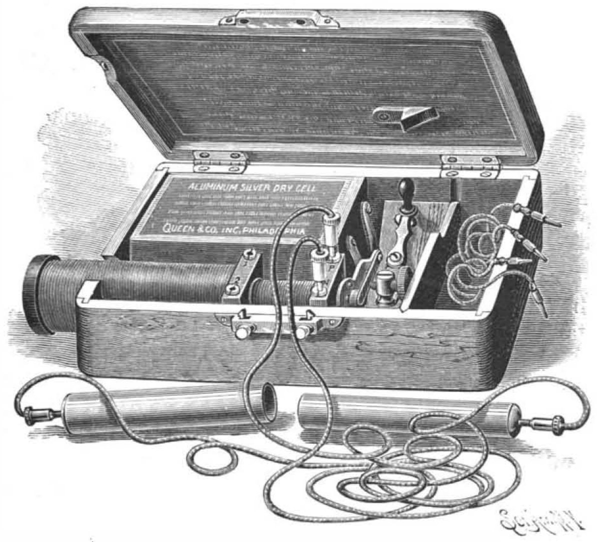


Fig. 4.—SOUND OF THE PELOBATIDES.

Fig. 2.—HANDEL'S ISRAEL IN EGYPT.

that Haydn, Ramberg and their imitators, who have introduced into the orchestra of their "infantile symphonies" the cuckoo, the quail, the nightingale, and the wild cries of the kestrel, have entirely forgotten the jovial songster of the swamps. Handel alone has taken pity on these animals, and made mention, in his "Israel in Egypt," of the toads and frogs. By his peculiar accompaniment, he imitates in his oratorio the motions and the leapings of the frog. We give the famous passage of the oratorio in question in Fig. 2.



A DRY CELL FARADIC BATTERY.

As regards the notation or reproduction of the noises of the frog, that is not any easy thing to do; far from it. Yet Landois has endeavored to note a few of the "songs" that ring out upon the edges of the ponds and swamps, and it must be confessed that the attempt of this learned author has not been entirely unsuccessful. Thus, the music of Landois, executed by a harsh, youthful voice, is capable of recalling pretty closely the croaking of the green frog. The music in question is given in Fig. 1.

Although the notation of the croaking of the green frog (Rana esculenta) is difficult, the registering of the jerky notes of the spotted frogs and tree frogs is quite easy. The spotted frog, which is generally considered mute, nevertheless utters shrill sounds and plaintive cries when it is struck or when it is attracted by a mole or some aquatic rat. It has none the less a "song," which is quite simple, it is true, at the period of spawning.

It is well to take into consideration the fact that the males alone "sing." We know that the period of spawning with the spotted frog is relatively early as compared with that of the green frog. As soon as the first spring pools appear and the snow disappears from the fields and meadows, the spotted frogs come forth from their winter quarters and proceed to deposit their spawn upon the edges of the ponds. Mr. Zograf reates that in the vicinity of Moscow the music of this frog begins as early as the month of March. Formerly, by reason of the prolonged thaws, the frogs were deceived and made their exit from their winter quarters earlier. The spotted frog does not utter melodies of long duration, as is the case with his relative the green frog, but merely repeats a single note with a surd bass voice (Fig. 4).

As regards the tree frogs and the Pelobatides, their voice is sonorous and clear, and may be compared to the sounds of a silver bell. We would remark that it is, for the most part, representatives of the Pelobatides that, at the beginning of twilight or in the evening, are heard repeating the sound "wok" or "oonk" with a clear and sonorous voice at the margin of stagnant water. This is why these animals are called "wok" by the peasants in certain districts. As their voice very frequently resounds on dark nights when the sky is covered with heavy clouds, the people become frrghtened when they hear the characteristic "wok" and "oonk," for they see a connection between these strange sounds and the tears of the souls of the drowned. It is especially in the isolated villages of Russia that this belief is prevalent. Numerous examples of it might be cited. Thus, the Russian novelist, Ivan Tourgeneff, mentions it in his admirable work, Biejuine Lougue. The sounds of these frogs vary between fa and do (Fig. 4).

It remains for us to say a few words concerning the "music" of toads. Let us say at once that it is very simple and not very harmonious. Here again it is during the period of spawning that the most noise is made. Their songs vary according to the species. Thus, for example, the Bufo variabilis has a harsh, jerky voice, while the B. cinerius emits a sound like that of the representatives of the Pelobatides, although its voice is not so strong. As for the rush toads, the male of which is provided with a vocal sac, and which makes itself heard at the beginning of twilight, they cry now "glookglook" and now "rahrah," like the frogs. Mr. Zograf, moreover, tells us that he has heard them utter a prolonged "Ker-r-r-r-r."

In a general way the sounds of frogs may be registered as follows: "Brekeke-brekeke, krekete! Kpate too-oo-oo! brekete, brekete! brekete, kwarr, brekete, too-oo !"—La Science en Famille.

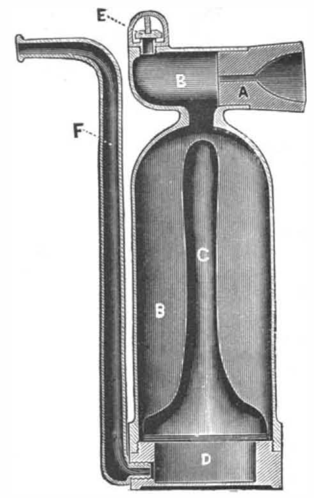
"DRY CELL" MEDICAL BATTERIES.

The illustration represents a new form of "Dry Cell" Faradic Battery, placed on the market by Queen & Co. (Inc.), of Philadelphia. This type is specially adapted for home use (preferably under the advice of a physician) and is extremely compact, convenient to handle, and durable, thus being admirably suited for carrying about when traveling. The cells are sealed, so that there is no leakage of acids, as in older forms, and the battery is perfectly clean and "nice."

Three sizes are made, all mounted in handsome mahogany boxes. Size No. 1 contains two cells and will produce a current stronger than most people can endure, which, however, can be graded down so as to be imperceptible to the most sensitive nature. The change is effected gradually, by sliding the secondary coil on and off the primary. A special switch shuts current off entirely when the case lid is closed. Size No. 2 is larger than the preceding, and contains four dry cells instead of two. There is also a difference in the method of current regulation, which in this style is accomplished by a switch "controller." Battery No. 3 or Physician's Battery No. 1 is the largest of the series, and is amply sufficient for the requirements of most doctors who want a compact and portable apparatus. The cell block contains six cells, which produce a very powerful current. Samples of the batteries were exhibited at the World's Fair and received the highest award for "compactness; range of action; efficiency, and beauty of workmanship." The examining judge was Dr. W. J. Herdmann, of Ann Arbor, Mich. When the cells in any of the above become exhausted (which occurs only after long service), they can readily be renewed at a slight expense, by sending the containing block to the makers.

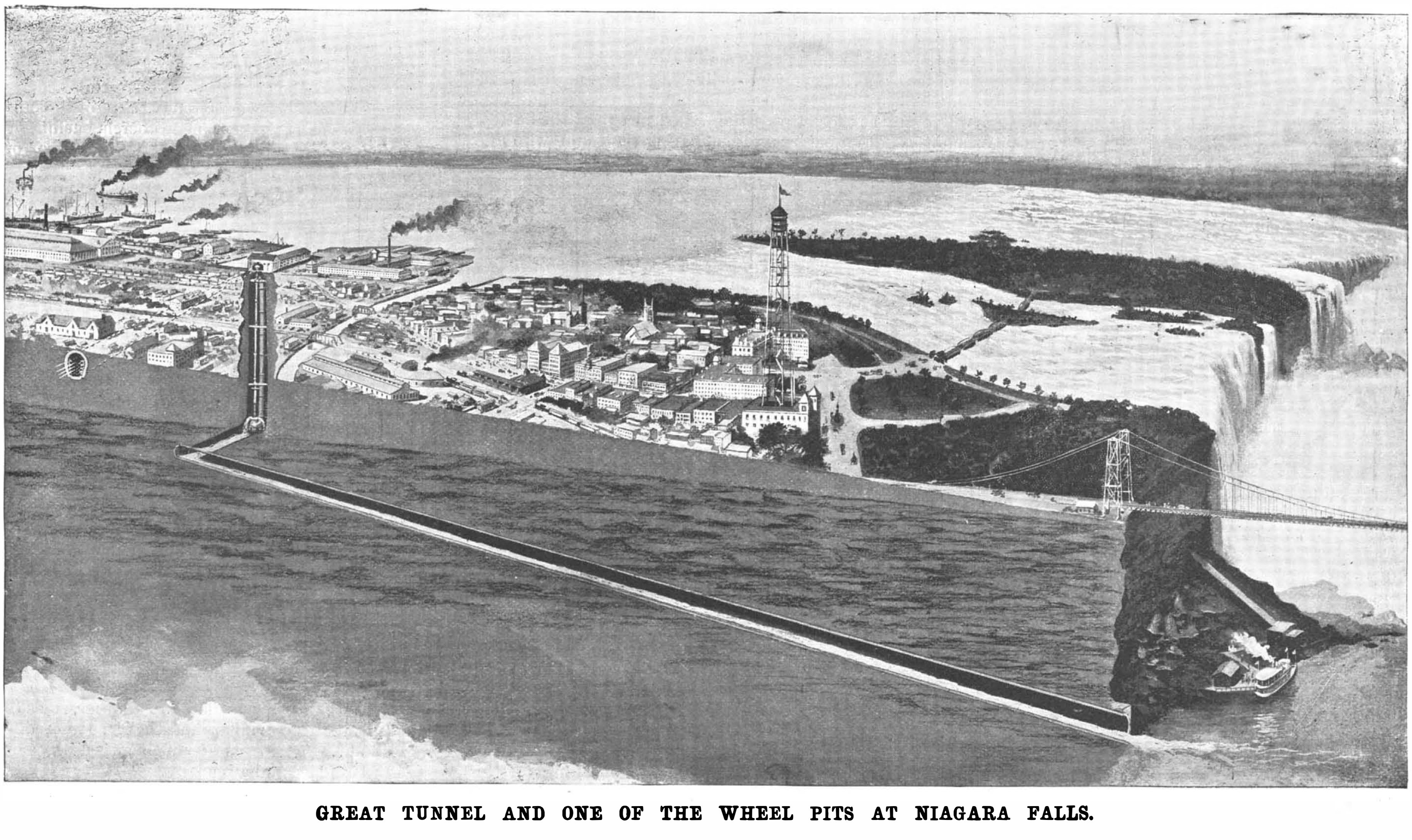
THE HARMLESS SMOKER.

The design shown in section in the illustration, which has been recently patented by Mr. Ryerson D. Gates, of Chicago, has already been introduced to a considerable extent, the object of the device being to break off and cure the tobacco habit. This is accomplished by means of a delusion which does not deprive the "user of the weed" of the pleasure of smoking, but does away with the evil effects of the habit. With it, one smokes a cigar without drawing any smoke into the mouth or down into the lungs, and is at first so deceived by the effect as not to distinguish the difference. A rubber bulb, C, is in free communication with a chamber, D, in the base, with which the stem, F, is connected, and by drawing on the latter the suction causes sufficient collapse of the bulb—which is shown in collapsed form in the picture—to create a partial vacuum in the surrounding smoke chamber, B. This draws the smoke through the small end of the cigar, placed in the tip, A, and when the lips are opened in the natural way the expansion of the bulb forces the smoke out of a valve, E, immediately below the nostrils, but no smoke comes out of the mouth. It is impossible to get any nicotine in the mouth by smoking in this way, and cancer of the throat and similar troubles caused by smoking are simply out of the question.



UTILIZING THE WATER POWER OF NIAGARA FALLS.

In the SCIENTIFIC AMERICAN of March 5, 1892, we gave a full description, with numerous illustrations, of



GREAT TUNNEL AND ONE OF THE WHEEL PITS AT NIAGARA FALLS.

the work on the great water power tunnel, 7,250 feet long, at Niagara Falls, showing also the extensive scale on which the supply canals were laid out, and the general arrangements for utilizing a water power of about 125,000 horse. The first mill to make use of the power rendered available by the tunnel was that of the Niagara Falls Paper Company, for some months past using 3,000 horse power, to be increased to 6,000 horse power. A concrete subway is also ready for the wires of the Pittsburg Reduction Company, whose plant is about 2,500 feet from the power house, from which the company will be supplied with about 3,000 horse power for use in the reduction of aluminum. The arrangements for the electrical transmission of power to the city of Buffalo are also nearly completed. This power is to be transmitted by means of wires carried upon poles from a 50,000 horse power electric station which the Niagara Falls Power Company have near completion on the main canal. The right of way has been acquired, and all the contracts made for two lines, one of which crosses Grand Island while the other follows down the shore. Two lines are provided that one may be held in reserve, the line through the island being 13½ miles long while that following the shore has a length of 18¼ miles. The Cataract Construction Company also own a controlling interest in a company which is developing the water power of Niagara on the Canadian side of the river, and wires from the Canadian station join those of the main line on Grand Island. The transmitting line reaches Buffalo just inside the city limits, where the power will be taken by a Buffalo company formed for its distribution in the city.

In the electric power station three turbines of 5,000 horse power each are in position, and the dynamos are ready to be placed. They are of the Westinghouse alternating system, each with its revolving field directly connected to the vertical shaft of a 5,000 horse power twin turbine built from prize designs, furnished, after a severe competition, by Messrs. Faesch & Piccard, of Geneva, Switzerland. The wheels are of the Fourneyron or Boyden type, and work 250 revolutions per minute under about 140 feet head. They are of cast bronze of the quality used for propellers of steamships. The water is delivered through a seven foot penstock into the center of the turbine, being discharged upon the 32 blades of the wheel through directing passages formed by 36 deflecting plates. It is expected that the governing mechanism will control the speed under ordinary changes of load with a variation so slight as to be hardly perceptible, gates controlled by the governor opening more or less of the discharge opening, and the efficiency of the wheel being proportionally maintained with only a third of the full gate opening. The weight of the vertical shaft in the wheel pit is sustained by closing the bottom of the casing and causing the water to push upward upon the underside of the disk carrying the blades of the upper turbine. The shaft is of rolled steel tubing about a foot in diameter, with smaller solid portions in the journals, and no fly wheel is required, the heavy fields of the dynamo carried on the shaft affording sufficient momentum and inertia.

The dynamos are constructed upon the two-phase alternating current system, with stationary armature and revolving fields, and are designed to generate a potential of 2,000 to 2,400 volts, which will be increased or diminished by step-up or step-down transformers for transmission or local use. Motor generators will be run for the production of continuous current when required, so that the station will be able to furnish continuous or alternating current of any potential. Two-phase Tesla motors will be used. The station is designed eventually to comprise ten units of 5,000 horse power each, and the wheel pit and building will be extended toward the river and new wheels put in as required. Meantime power from the station itself will be available for carrying on the work, extending the wheel pit and the main tunnel, and the many mechanical operations connected with grading and inaugurating the industrial city which will grow up about this source of cheap and continuous power.

Ruskin on the Locomotive.

In a recently published volume of lectures by Ruskin he says:

"I cannot express the amazed awe, the crushed humility, with which I sometimes watch a locomotive takes its breath at a railroad station, and think what work there is in its bars and wheels, and what manner of men they must be who dig brown ironstone out of the ground and forge it into that! What assemblage of accurate and mighty faculties in them; more than fleshly power over melting crag and coiling fire, fettered and finessed at last into the precision of watchmaking; Titanian hammer strokes, beating out of lava these glittering cylinders, and timely respondent valves, and fine-ribbed rods, which touch each other as a serpent writhes in noiseless gliding, and omnipotence of grasp; infinitely complex anatomy of active steel, compared with which the skeleton of a living creature would seem, to a careless observer, clumsy and vile—a mere morbid secretion and phosphatous prop of flesh. What would the men who thought out this, who beat it out, who touched it into its polished calm of power, who set it to its appointed task and triumphantly saw it fulfill this task to the utmost of their will, feel or think about this weak hand of mine, timidly leading a little stream of water color which I cannot manage, into an imperfect shadow of something else—mere failure in every motion, and endless disappointment? What, I repeat, would these iron-dominant genii think of me, and what ought I to think of them?'

DECISIONS RELATING TO PATENTS.

U. S. Circuit Court—District of Massachusetts.

EDISON ELECTRIC LIGHT COMPANY ET AL. v. BOSTON INCANDESCENT LAMP COMPANY ET AL.

This was a suit by the Edison Electric Light Company and others against the Boston Incandescent Lamp Company and others. Complainants moved for a preliminary injunction.

Colt, J.:

The second claim of the Edison incandescent lamp patent (No. 223,898) is for "the combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which the receiver the air is exhausted, for the purposes set forth."

The defendants' lamp, constructed after the Pollard patent of November 1, 1892, contains all the elements enumerated in this claim, namely: a carbon filament, all-glass receiver, from which the air is exhausted, and conductors passing through the glass. The only difference between the two lamps is that the defendants use a film of powdered silver for the conductors passing through the glass in place of platinum wire, which Edison points out in the specification of his patent as the material to be employed and which is always found in the Edison lamp of commerce. In other respects the lamps are identical. While Edison uses platinum wire, he does not limit himself to this form of conductor in his claim. The language of the claim is "conductors passing through the glass," and therefore, on its face, the claim covers all kinds of material capable of carrying the electric current. If the claim had been limited to conductors of platinum wire, as the filament is limited to carbon, the case might be different.

The invention of Edison resides in the carbon filament. The other elements of the combination were old and subordinate and represent, so to speak, only the environment of the filament. For this reason I do not think the court should seek to restrict the plain meaning of the language of the claim. And there is another reason for giving the claim a broad construction. Edison made an important invention. He produced the first practical incandescent electric lamp. The patent is a pioneer in the sense of the patent law. It may be said that his invention created the art of incandescent electric lighting. Where a valuable invention has been made, the court will uphold that which was really invented and which comes within any fair interpretation of the patentee's claim. (Merrill v. Yeomans, 11 O. G., 270; 94 U. S., 568,573.)

The argument of the defendants is that this claim of the Edison patent must be limited to the use of platinum wire as a conductor, or its known equivalent, and that powdered silver was not a known equivalent at the date of the Edison patent. Looking generally at the state of the electrical art at the date of the Edison patent and comparing platinum wire and powdered silver simply as elements, apart from any specific combination or invention, it cannot be said that one was not a known equivalent of the other, because powdered metals, including silver, have been recognized since 1860 as conductors of electricity. In asserting that powdered silver was not a known equivalent of platinum wire, the defendants must mean that it was not a known substitute in the combination or invention of the Edison patent or in the art of incandescent electric lighting, and I think the evidence proves this to be true; but, in dealing with an invention which is broadly new, I am not prepared to accept the proposition that, in order to constitute infringement, an equivalent in a patented combination must have always been known at the date of the patent or must have been such as would occur to a skilled mechanic exercising only ordinary mechanical skill.

While the language of the Supreme Court in Rees v. Gould (15 Wall. 187) and other cases seems to support the defendants' contention on this question, the later decisions by that court are not reconcilable with the broad proposition that in all cases the substitution of an equivalent will avoid an infringement, provided it was not known at the date of the patent, using the word "known" in its ordinary sense. (Morley Sewing Mach. Co. v. Lancaster, 47 O. G., 267; 129 U. S., 263; 9 Sup. Ct., 299; Clough v. Barker, 22 O. G., 2157; 106 U. S., 166; 1 Sup. Ct., 188; Union Paper Bag Machine Co. v. Murphy, 13 O. G., 366; 97 U. S., 120.) In the Morley case, Mr. Justice Blatchford, speaking for the Court, says:

"A difference in the particular devices used to accomplish a particular result in such a machine would always enable a defendant to escape the charge of infringement, provided such devices were new with the defendant in such a machine, because, as no machine for accomplishing the result existed before that of the plaintiff, the particular device alleged to avoid infringement could not have existed or been known in such a machine prior to the plaintiff's invention."

In that case the patent was for a machine for automatically sewing shank buttons to a fabric, and it was the first machine to accomplish this result. In the defendant's machine the feeding and sewing mechanisms were new and had been patented, yet the Court held that it infringed the Morley patent. The feeding and sewing devices of the Lancaster machine in the art of automatically sewing shank buttons to a fabric were as unknown at the date of the Morley patent as a conductor made of powdered silver at the date of the Edison patent in the art of incandescent electric lighting.

In dealing with a pioneer invention which creates a new art it hardly seems logical or reasonable to say that, because in the progress of such art some new substance or device has been discovered which can act as a substitute for one of the elements of the patented invention, any one can appropriate the invention by the employment of such substitute; and, further, if equivalency signifies equivalency in the particular combination or invention, it is difficult to point out in this class of cases what known equivalents existed at the date of the patent, for the reason that the combination of elements in which the invention is embodied was first made known by the patentee. The doctrine of equivalents as applied to primary inventions rests upon a more satisfactory basis by the elimination of the qualification of age or time and by holding those things to be equivalents which perform the same function in substantially the same way. The fundamental question is whether the alleged infringer makes use of the essence of the patented invention, not whether he has adopted a known equivalent or made a patentable improvement on the invention.

The motion for preliminary injunction is granted.

Tuberculosis and Butter.

It is hard to get away from the malign influence of the cow. Such at least is the case if we may trust the investigations of bacteriologists and sanitarians. The statistics of slaughtered animals in Prussia, Hanover, Switzerland, and other European countries show that from 2 to 12 per cent of the cattle are tuberculous, and though their flesh is not often dangerous, yet the milk must in most cases have been so. We can guard against tuberculous milk by sterilization, but now danger is threatened us from the butter. Several years ago Heim showed that butter from tuberculous milk contained bacilli and could produce infection. Bang (Deut. Zeitsch. f. Thiermed., vii., p. 5) reached similar conclusions.

Professor Roth, of Zurich, has, however, recently made experiments of more striking significance (Correspond. bl. f. Schweit. Aertz.) He went into the markets and purchased butter from twenty different sources representing different cantons of Switzerland. He then inoculated guinea pigs with this butter. In eighteen series of experiments the results were negative, but in two the inoculations were followed by tuberculosis. In other words, ten per cent of the butter of the Swiss markets contained tubercle bacilli.

Quite independently of Roth, Dr. Brusaferro, of Turin, made experiments with the butter of the Italian markets. In nine tubs he produced infection once, which gives about the same proportion as Roth's.

It is not to be supposed that 10 per cent of market butter is necessarily dangerous, for in many instances the number of bacilli is small and quite unable to cope with the juices of the stomach. Still, infected butter is not safe to the predisposed, and the fact of its existence in Europe at least should be borne in mind. What makes the matter additionally serious is the fact that there is not, so far as we know, any practical way of sterilizing butter.—Medical Record.

Mounting Photographs.

The satisfactory mounting of photographs is a troublesome operation, and the following suggestion from a contributor to the Outlook may be of assistance to amateurs: I have found a method by which a photograph or engraving can be mounted on the thinnest paper without curling or wrinkling. If the picture is a photograph, it should be ironed out smooth with a hot iron and then trimmed. Mix a little gum arabic in hot water, so as to make a rather thick mucilage. Place the picture on the page in position and mark just inside the corners. Remove the picture and take some of the mucilage on a ruling pen and draw a heavy line of mucilage from one point to another, so as to make a line of mucilage all around the place where the picture is to be. As soon as the mucilage is sticky put the picture in place and a book over it to keep it flat. When dry, you will have a smooth mount that will not curl.

THE GREAT CHICAGO CANAL.

The headwaters of the Des Plaines River lie in Wisconsin near Lake Michigan. The river runs to the south approximately parallel with the western shore of the lake, and, after it has reached the parallel of Chicago, trends to the southwest, and passing through Joliet, joins its waters with those of the Kankakee River, forming the Illinois River. The combined waters run through the channel of the Illinois River to the Mississippi, emptying into it a short distance above the mouth of the Missouri River. Through the city of Chicago winds the small stream called the Chicago River, a devious creek with several branches. This enters into the lake. A distance of a little over ten miles intervenes between the lake shore and the Des Plaines River at Chicago, while between the Chicago River and Des Plaines River but two miles intervenes. At present much of the sewage of Chicago runs into the lake, threatening with contamination the water supply of the city, notwithstanding the fact that the intake of the water works is situated some miles out in the lake. Largely to avoid this contamination, the great drainage works which we describe and illustrate have been undertaken.

It will be seen that at Chicago there is a true divide, the waters on the east pouring into Lake Michigan, and on the west reaching the Gulf of Mexico, through the channels of the Des Plaines, Illinois and Mississippi Rivers. Should the divide be pierced, the waters of Lake Michigan would run into the Gulf of Mexico as well as into the Gulf of St. Lawrence, and an internal waterway from the British Provinces through the St. Lawrence and the great lakes to the Gulf of Mexico would be created. At present work is being done on this connection, and if all goes well by 1896, the city of Chicago will have internal water communications with the Gulf of Mexico—communication to be utilized for the tranportation of freight, as well as for the disposal of her sewage.

While the operation of merely effecting water communication between the Des Plaines River and the lake by the Chicago River would be comparatively a small affair, the necessities of the case are such as to involve very extensive work and the excavation of one of the great canals of the world. The Des Plaines River in some seasons runs almost dry, so that its entire flow could pass through a six inch pipe; at other times what is described as a majestic flow of water, flooding the whole of its valley and passing through it at the rate of 800,000 cubic feet per minute. In order to secure the construction of a canal through the valley of Des Plaines River, a new channel in places has been made for the river at an outlay of nearly $1,000,000. This alone involved the excavation of 13 miles of new river channel, parallel with the main drainage channel, and 19 miles of levee had to be used to keep the water of the Des Plaines watershed out of the canal. The latter has to be restricted as far as possible to the one function, the conveying of sewage of Chicago, diluted more or less with the waters of Lake Michigan, to the lower Des Plaines River, near Joliet.

The levels of the canal are referred to as what is known as the Chicago Datum, 579·61 feet above the sea level of Sandy Hook, N. J. The bottom of the canal begins 25 feet below this level, and running on a down grade, follows the Des Plaines Valley to Joliet, where it is to join the main river. From the mouth of the Chicago River to Joliet is a distance of 35 miles. This involves considerable excavation, reaching in places a depth of nearly fifty feet. The present aspect of the works is quite impressive. At places in the rock the excavation is practically completed, while elsewhere operations in earth, peat, and rock are actively in progress. The general course of the canal is slightly sinuous, and the parts under contract between Lockport and Chicago are divided into 29 sections, each section approximately one mile in length. The grade to be followed is so steep—about forty-two feet in four miles, at the steepest part—that a very strong current would be established. For reducing the flow, accordingly, controlling works are to be introduced at the western end for keeping back the flow. As it is proposed to use the canal for barges, some of which will be 500 or 1,000 tons capacity, provision will be made for passing around the dams by means of locks.

The great freshets to which the Des Plaines River is exposed brings out the question of supplying an adequate outlet for water. Accordingly, a spillway is provided at the head of the river works proper, or "river diversion," as it is called, which are to be so proportioned that when the flow exceeds 300,000 cubic feet per minute, the excess will flow over the spillway and toward Chicago, finally going into the lake.

The river diversion channel on the bottom is 200 feet wide; side slopes, 1½ to 1. Its general grade is 0·12 per 1,000 feet. The canal proper varies in width, its maximum section providing for a total flow of 600,000 cubic feet per minute, enough for the sewage of a population of 3,000,000. This is the legal capacity of the canal. In softer ground, however, where dredging at any time will be applicable, the channel is reduced to about one-half this capacity. The idea is that, as the population increases, the narrow portions can be dredged out.

The portion of the canal now being constructed is in the hands of numerous contractors, and for executing the work these contractors have selected their own plant, and the consequence is that the most varied class of machinery is employed on the works. Our illustrations give examples of the more striking and original types. Fig. 1 shows the direct application of horse power for excavation in the New Era grader. This great machine, drawn by its team of eight draught animals, cuts away the soil and delivers it one side to a spout by belt conveyor. At the end of the spout team after team draws its wagon to receive the spoil, the work going on practically without break. It has been applied for removing the upper seven feet of earth on some sections.

Fig. 2 shows one of the high power derricks, whose operations are obvious. With its long booms and rotary movement it transports the material from the center of the canal to the banks, perpetually turning about on its own axis. These have not proved as economical as anticipated.

Hydraulic dredging has its exponent in the Bates hydraulic dredge, shown in Fig. 3, used for cutting away peat and similar materials. From the booms in front of the dredge is suspended what may be called a giant milling machine—a wheel with blades rotating on a horizontal axis and cutting through the turf to right and left as the dredge is moved and fed to its work. From the vicinity of the cutting wheel a pipe runs to the dredge, connected to a rotary pump, by which the material is pumped through the long pipe seen running astern floated on pontoons, and which may deliver the soil 3,000 or more feet away. These dredges average a rate of 100,000 cubic yards per month, which, as it includes delivery as well as removal, is a most remarkable result.

Fig. 4 shows one of the most striking machines and an impressive view of the work. Here are shown two of the giant Brown cantilever machines, working in a rock section. The sides, nearly vertical, have been cut in the solid rock by a channeling machine of which 57 have been employed at one time on the canal. On the bank the cantilevers travel on rails. The sloping trusses provide an inclined track for carrying up the loaded buckets and delivering their contents far up on the bank. The great trusses are 342 feet long and each machine disposes of 600 cubic yards per day, principally of rock blasted out by dynamite. One of these machines can deliver material from the far side of the canal over a mountain of debris 90 feet high. They are considered to represent the highest degree of efficiency.

Fig. 5 shows work on a rock section executed by cable conveyors. From trestle work abutments moving on tracks, cables are carried clear across the cut and are used for conveying the material to the side. As improved since their introduction, they compare with the cantilevers. Their original cost is about one-half that of the cantilevers. In the background of this cut can be seen the channeling machine at work, to whose operations are due the great regularity of the side walls. These views present some of the principal machines used, but cannot give an idea of the grand scale of the operations. The fact that seven tons of dynamite are used in a day in the removal of 14,000 cubic yards of rock gives an idea of the unprecedented magnitude of the operations.

The cross section of the canal varies. In rock a uniform width of 162 feet to a depth of 22 feet is provided for; in earth a width of 202 feet at the bottom is provided for, of the same depth. This gives a larger cross section of prism than that of any canal in existence. The nearest approach to it among existing canals is the North Sea Canal, and of canals in existence or proposed the Nicaragua Canal comes the closest.

The work is under the charge of the Trustees of the Sanitary District of Chicago. The State of Illinois, by statute passed in 1889, provided for the incorporation of sanitary districts. The sanitary district of Chicago applies to all the city north of Eighty-seventh Street together with some 43 square miles of Cook County. A population of about 1,400,000 inhabits the district. The trustees are elected by popular vote and are quite distinct from the municipal government of Chicago. They have the right to collect taxes to definite amounts stated in the law, and they can also issue bonds for the prosecution of their work.

The estimated cost for the work is $21,799,293.82. Operations began on September 3, 1892. November 1, 1896, is set as the probable date of completion of the entire work. The cutting represents two-thirds of the cost of creating a channel from Chicago to the Mississippi. Federal work on the Illinois and Mississippi Rivers is needed to complete the waterway from Chicago to the Gulf of Mexico.

TWENTY-FIVE miles of the Congo Railroad, forming the first section between Matangé and Kengé, are now completed. The work has cost $100,000 a mile. The line will be 98 miles long in all, and will connect the immense waterways above Stanley Falls with the sea.

The Golden Number and its Use—the Approximate New Moon for Two Centuries.

The golden numbers of a year are the numbers for any year in the metonic cycle of 19 years, on which the new moon falls upon the same day of the year as it did in the same year of the last or previous cycles.

The metonic cycle had a Greek origin, and was made to commence with the year in which the new moon falls on the 1st of January; and as this happened in the year preceding the commencement of the Christian era, hence to find the golden number for any year, add 1 to the date and divide by 19. The quotient is the number of cycles elapsed, and the remainder is the year of the cycle, or the golden number. Should there be no remainder, the year will be the last of the cycle, for which 19 is the golden number.

By tabulating the golden numbers to correspond with the months and days for one cycle, they will correspond with the numbers for any cycle for one or two centuries in which there is no leap year at the beginning of a century, and will be reliable to the fraction of a day, which may, in a few cases, make the tabulated date have an apparent variation of one day, but mostly with an error not exceeding 12 hours.

In the following table the golden number, as in the computation above stated, will be found in the column of the months opposite to the day of the month, and by tracing the golden number for the year through the monthly columns, the days of new moon throughout the year will be shown approximately within the fraction of a day. For example, for $1895: 1895 + 1 = \frac{1896}{19} = 99$ cycles and 15 remainder, which is the golden number.

In the table this falls on January 25, and tracing the number through the months, February 23, March 24, and consecutively one day later through the following months of the year.

TABLE OF APPROXIMATE NEW MOONS FROM 1801 TO 1999.

Day of month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	9		9	17	17	6				11		19
2		17			6	14	14	3	11		19	
3	17	6	17	6			3	11		19	8	8
4	6		6	14	14	3			19	8		16
5		14			3	11	11	19	8		16	
6	14	3	14	3			19			16	5	5
7	3		3	11	11	19		8	16			13
8		11			19	8	8	16	5	5	13	
9	11	19	11	19						13		2
10			19	8	8	16	16	5	13		2	10
11	19	8					5	13	2	2	10	
12	8	16	8	16	16	5				10		18
13					5	13	13	2	10		18	7
14	16	5	16	5			2	10	18	18	7	
15	5		5	13	13	2				7		15
16		13			2	10	10	18	7		15	
17	13	2	13	2			18	7		15	4	4
18	2		2	10	10	18			15			12
19		10			18	7	7	15	4	4	12	
20	10	18	10	18			15			12	1	1
21	18		18	7	7	15		4	12			9
22		7			15	4	4	12	1	1	9	
23	7	15	7	15			12			9	17	17
24			15	4	4	12		1	9			6
25	15	4			12		1	9	17	17	6	
26	4		4	12		1				6		14
27		12		1	1	9	9	17	6		14	
28	12		12		9		17	6	14	14	3	3
29	1		1	9		17				3		11
30		×			17	6	6	14	3		11	
31	9	×	9	×		×	14	3	×	11	×	19

Historical and Traditional Accounts of the Fall of Aerolites.

Every country and every age has its historical, semi-historical, or traditional stories concerning immense stones falling from the sky, or more properly, from space. Levi tells of a whole shower of aerolites which fell on the mountains near Rome in the year 654 B. C.

The Arundel marbles (marble tables giving the events of the Grecian history from 1582 B. C. to 624 B. C. in chronological order) give an account of a great stone which "fell down from heaven" at Æogostami about the year 467 B. C. Pliny, who died in the year 79 A. D., says that in his time the "great air stone" mentioned in the foregoing was still to be seen on the Hellespont, "and," he quaintly adds, "it is even now of the bigness of a wagon."

Since the opening of the present century there have been several well attested instances of falls of stone from the regions of space. In the year 1803 a perfect shower of litho missiles fell in the farming country adjacent to L'Aigle, France, upward of 3,000 separate stones falling upon a wedge-shaped section of country eight miles long by about four miles wide.

Aerolites, or "meteorites" as they are sometimes called, usually fall singly, sometimes in pairs, and less frequently in showers, as was the case at New Concordia, O., in 1860, when nearly 200 red-hot stones fell in a field in broad daylight.

Up to January 1, 1894, there had been between 300 and 350 instances recorded of stones falling from the unknown regions outside of our atmosphere, and in eight of these the fall was in the shape of "showers," three individual missiles numbering from 10 to 5,000 and of all sizes, from that of an orange to immense blocks of strange combinations of minerals weighing hundreds of tons.—Baltimore Herald.

THE METROPOLITAN CLUB.

New York is now as much a city of clubs as London, and it is possible to find in the metropolis clubs for nearly every phase of social life, religious belief, or political opinion, while nearly all professions and nationalities are represented in the long list of clubs devoted to riding, driving, fencing, whist, chess, dancing, dining, and many other interests and amusements. One of the youngest but most prominent of the clubs in New York is the Metropolitan Club, whose palatial club house at Sixtieth Street and Fifth Avenue forms one of the ornaments of that beautiful part of the city. The Metropolitan was organized February 20, 1891, in order to fill the want of those living in the upper part of the city near the Central Park, none of the leading social clubs being within a mile or more of that part of the city. The club house was opened last spring, and is probably the most magnificent club building in the world, costing, including the ground and furnishings, about two millions of dollars. The plot of ground measures one hundred by two hundred feet, while the building is ninety by one hundred and eighty-five feet, and is one hundred feet high. The edifice was constructed from designs furnished by Messrs. McKim, Mead & White, the well known architects of the Madison Square Garden.

The club house is built of white marble and is constructed throughout in the most fireproof manner. Our illustration shows one of the salient features of the entire structure, the main entrance. The beautiful gates and grilles were made by John Williams, of this city, and are fine examples of artistic iron work. The portion of the building shown through the main gate is the ladies' annex, an arrangement similar to that adopted in the Somerset Club, Boston. The court yard is of ample size.

The great hall is a magnificent affair fifty-two by fifty-five feet and forty-five high, and is lined entirely with marble of different kinds.

The rooms are furnished in the most sumptuous manner, and by no means the least successful feature of the large drawing and lounging rooms are their magnificent proportions. The main room on Fifth Avenue is 85 feet long, and the ceilings throughout are of magnificent altitude. There are three distinct dining rooms, besides a number of private dining rooms. There is the main dining room for the use of members only, and a large dining room for use of visitors, guests of members of the club, who are not admitted to the main room, and in the ladies' annex a delightful suite of rooms, where members may entertain ladies as their guests. At the top of the house are a number of bedrooms rented to members of the club, and above all the kitchen. A delightful roof garden has been arranged for the use of the members during the summer months. The outlook from the club windows upon the plaza at the main entrance of Central Park and up and down Fifth Avenue is not surpassed by anything in the city. The illustration gives a view of the main entrance and driveway on Sixtieth Street.

MAIN ENTRANCE, METROPOLITAN CLUB, NEW YORK.

Petroleum as a Lubricant.

We give below an abstract from a paper read by A. W. Harris, Providence, R. I., president of the Harris Oil Co., on the history and use of petroleum. After reviewing the history of the discovery of petroleum, the writer says:

The peculiar advantages of petroleum as a lubricant over all other oils are its non-oxidizable properties. This means its freedom from gumming and acids. All other oils, animal, fish and vegetable, which were used prior to petroleum, are destructive to metals, and this destructive action is more noticeable where these oxidizable oils are used to lubricate the valves, cylinder and other internal parts of the steam engine. This destruction is accelerated by the high degree of steam heat, which causes the quick generation of stearic, margeric and oleic acids, that rapidly act on the metal surfaces, honeycombing them and eating them away.

I wish now to add a word on the importance of temperature to lubrication. The uniform temperature where machinery is operated is a very important factor, as well as the uniform gravity and cold test of the oil to lubricate it, as is illustrated by the ordinary drop-feed lubricating cup, which is regulated by the opening or closing of an aperture near its base. It is plain to be seen that as often as the temperature of the atmosphere changes, or the gravity or cold test of the oil is changed, so will the quantity of the oil fed through the aperture of the cup vary in furnishing the uniform quantity necessary to lubricate the machinery properly. Many expensive accidents have been caused by neglecting to observe the above factors.

Lubrication is a very important factor in engineering; every engineer should understand how to determine its value by testing. The various tests to determine the value of petroleum are as follows: The flash or fire test; the cold test; the endurance or lasting qualities; the viscosity. The instrument used for determining the flash or fire test of oils is very simple. It consists of a vessel that has a holding capacity of two ounces of oil, of the following dimensions: One and a quarter inches diameter by one and three-quarter inches long. A holder is arranged to hold this cup that will admit of an alcohol lamp being applied at its base. A thermometer is immersed in it when the oil is sufficiently heated to generate a flash by the application of a lighted taper to its surface. The gas will ignite and produce a flash. Quickly observe the record of the thermometer. If it registers 360°, the oil is called 360 flash test oil; if the heat is continued, the oil will take fire on its surface, say, at 400°. This is the fire test, and would be known as 400 fire-test oil. Cold test can be made by using an ordinary four-ounce bottle filled with oil to be tested, a thermometer immersed in the oil and set in a cool place; when the oil congeals at a temperature of 35°, this is denoted the cold test.

The machine for testing the endurance of oil is constructed as follows: A shaft thirty inches long, turned and ground to two and one-half inches in diameter, supported at each end by bearings and arranged to rotate at various speeds; a pair of half-moon boxes is nicely fitted to this shaft. Immersed in a cavity filled with oil in the top box is a thermometer, and oil holes made to receive a given quantity of oil to be tested. The boxes are held together by a weighted lever, thrusting the boxes against the shaft with the required pressure per square inch. One end of this shaft is fitted to a dynamometer to denote the friction between boxes and shaft. When the shaft is set in motion the temperature of the boxes is noted; also the increase of friction by the dynamometer. As the box commences to increase in temperature, and the oil is partly consumed, the friction on the dynamometer increases. The number of minutes is noted from the starting up to stopping, and the result of the test is as follows: Eight drops of oil are used for the test of 30 gravity and of 350 flash test, which lasted, under a pressure of 400 pounds to the square inch, twenty minutes. The reading of the thermometer to start with was 70°; at the close of the test, 140°. Amount of power consumed by the dynamometer to start with was one-sixteenth of a horse power; at the termination of the test, one-eighth horse power; revolutions of shaft, 400. Another oil may be tested under the same conditions and the relative qualities of lubrication and economy intelligently compared.

The viscometer is a substitute for the hydrometer, for testing the gravity or density of oils. It is constructed as follows: A vessel containing one pint, arranged with an orifice of one-sixteenth of an inch in diameter, is made at the bottom of the vessel, a thermometer is immersed in the oil and a uniform temperature is maintained. The quantity of oil that will flow through this orifice in a given time at a given temperature is called the viscosity of the oil.

The refiners and dealers have not, to my knowledge, agreed to adopt any particular construction of viscometer as a standard. When there is one universally adopted, and the tests come from reliable sources, we shall have a standard unit of viscosity which we shall have confidence in.

Spanish Iron Ore.

Bilbao now supplies about a fifth part of the iron ore yearly consumed in the United Kingdom. With regard to the output of iron ore in Biscay, and exports for the last 16 years at the rate of 3,000,000 to 4,000,000 tons per annum, the question has often been raised how long the mines may be expected to continue this yield. This is a matter very difficult to forecast, but it may be observed that the number of mines yielding good quality ores is becoming smaller, with the inevitable result that in the course of time the exportation will decrease, while the quality will deteriorate.

A Wire Fence Telephone Wanted.

"Down in Texas," says an electrical salesman, in Electrical Review, "I think there is a good demand for a telephone that can talk over 100 miles of barbed wire fence. On the ranches cowboys are kept 'riding the fence,' that is, riding up and down a section of barbed wire fence, inspecting it and keeping it in order. Many ranches are twenty, thirty, and fifty miles square, and if a serious break in a fence is found, the cowboy must ride back to the ranch to report. Now if a good telephone could be provided for each section, it would save all that riding. The staples holding the two top wires to the posts could be removed, insulators put in their places, and a man would have a complete metallic telephone circuit around his ranch."

THE UNITED STATES RAM KATAHDIN.

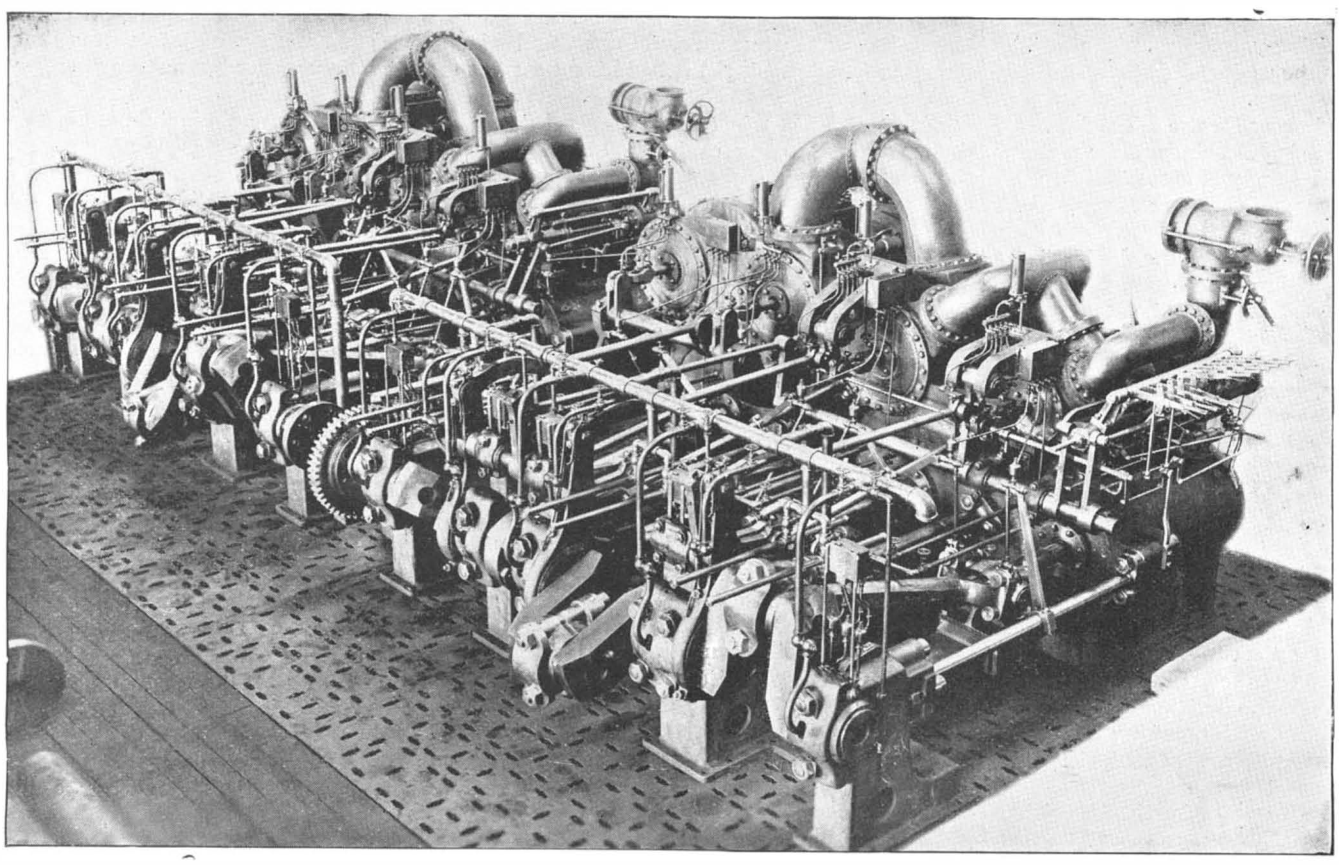
The possibilities of what may be accomplished by the ram in naval warfare have long been the subject of argument among naval experts, but the most important vessel ever specially designed and built for this purpose expressly is now nearly ready to be put into commission, i. e., the ram Katahdin, the engines of which are shown in the accompanying illustration. She was built after the plans of Rear Admiral Ammen, with whom the subject had been a favorite one for many years. She is a twin screw armor-plated vessel designed on the longitudinal and bracket system, with an inner bottom extending from the collision bulkhead to the stern. The longitudinals and girders supporting the deck are to be continuous, converging to the stem casting and to the stern, the frames and beams to be intercostal; the depth of longitudinals and vertical keel throughout their length to be 24 inches, the girders supporting the armored deck to be 15 inches. The vertical keel, two longitudinals, and armor shelf on each side of the vertical keel are to be watertight, forming transversely six compartments, these being divided longitudinally by watertight frames. By this means the space between the inner and outer skins is subdivided into seventy-two compartments. The transverse and longitudinal bulkheads between inner skin and deck armor divide this space into thirty compartments, making a total of 102 compartments in the vessel. The vessel is to be provided with a removable wrought steel ram head, to be accurately fitted and securely held in position in the cast steel stem. The principal features are:

Length over all	243 ft.
Length on load water line	242 " 9 in.
Breadth, extreme	43 " 5 "
Breadth on water line	41 " 10 "
Draught amidships	15 "
Displacement	2,050 tons.
Indicated horse power	4,800 "
Speed	17 knots.

The outside strake of the deck armor is to be six inches in thickness, the next strake inboard to taper in thickness in its breadth from 5½ to 2½ inches, the remainder of the deck plating to be 2½ inches in thickness, including the lower course of plating. The side armor is to be two strakes in depth, the upper 6 inches in thickness and the lower 3 inches, to be secured by bolts with countersunk heads, driven from the outside through wood backing of yellow pine and two backing plates, each 20 pounds per square foot, and set up with nuts on rubber washers. All hatches through the armored deck are to have battle plates, and the smoke pipe and ventilators to have inclined armor 6 inches in thickness. The conning tower is to be 18 inches in thickness.

There are two engines, horizontal, direct acting, triple expansion, driving twin screws, the cylinders 25, 36, and 56 inches diameter, respectively, and with 36 inches stroke, common, with 4,800 horse power when making 150 revolutions per minute. The main steam valves are of the piston type, one for each high and intermediate and two for each low pressure cylinder, driven by Marshall radial gear, with compensating rock shafts, and all the valve gear except the rock shafts being interchangeable. The engine keelsons are built in the ship and the cylinders cast with brackets attached to be bolted together and to the keelsons. The cylinders are also attached by forged steel tie rods to the bed plates and engine frames. There is one forged steel piston rod for each engine, with a crosshead working on a cast iron bar guide, the valve stems being of forged steel. The crank shafts are in two sections for each engine, of mild forged steel, 10¾ inches in diameter in the journals and 11 inches in the crank pins, there being axial holes 5 inches in diameter through shafts and pins.

There is to be a complete installation of electric lights sufficient for lighting all parts of the vessel, and arranged in duplicate so as to guard against accident. The drainage system is to be so arranged that any compartment can be pumped out by the steam pumps. The vessel is to be submerged to fighting trim by means of valves, one in each transverse watertight compartment of the double bottom; and sluice valves are to be fitted in the vertical keel and the watertight longitudinals in these compartments. The only projections above the armor deck are the conning tower, smoke pipe ventilators, hatch coamings and skid beams on which the boats are supported. The vessel has no armament, and is to rely entirely on the ramming for her offensive power.



ENGINES OF THE NEW UNITED STATES RAM KATAHDIN.

Protection of Iron Columns.

Some experiments were recently made by the Buildings Inspection Department, Vienna, on the protection of iron from fire by incasing it with brick. A wrought iron column, 12 ft. long, and built up of two channels connected by lattice bars, was used. This was set up in a small chamber constructed of brick, and the column was loaded by levers. This done, it was surrounded by a 4½ in. brick wall laid in fireclay mortar. The wall did not fit closely round the column, and advantage was taken of this to fix there samples of fusible metals, and which should serve as a gauge of the temperature attained. Various samples of stone concrete and other materials were also placed in the chamber within the column. This chamber was then filled with split firewood, which was lighted and the doors immediately walled up with slabs of plaster of Paris. After the fire had burned out, the doors were broken in and a stream of water turned into the room from a 14 horse-power fire engine. An examination of the room next showed that the walls of brick laid in Portland cement retained their strength, while most of the natural stones left in the chamber had been destroyed. The ceiling had been lined partly with plaster of Paris and partly with terra-cotta tiles. Both were damaged. The inclosure round the iron pillars was still standing firm, though corners of the brickwork were chipped 1 in. or so, and the fireclay mortar was largely washed out of the joints. On removing the casing, however, the pillar inside was found to be uninjured, even the paint being unscorched, and the fusible plugs only showed a temperature of 149 deg. Fah.

ACCORDING to a French journal, a Geneva firm is manufacturing phonographic clocks which talk the hour instead of striking it.

Mending Cracked Negatives.

To make a cracked negative fit for use, Dr. Miethe recommends the following process: Place the broken negative, the film of which must be intact, film side down upon a metal plate which has been heated so that it can hardly be touched by the hand. The break is then covered with Canada balsam, which readily melts and fills up the cracks. To give the negative more stability, a large piece of the Canada balsam is put upon the center of the back of the negative, and a clean glass plate the same size as the negative is laid over all. The melted balsam spreads out evenly, the excess being squeezed out. After cooling, the plates are still further fastened around the edges with strips of Sheplie gum paper.

Explosive Coal Dust Experiments.

It is reported that, at the recent meeting in Newcastle of the Federated Institution of Mining Engineers, some experiments were shown by the Flameless Explosions Committee of the North of England Institute of Mining and Mechanical Engineers, with the object of illustrating the effect of coal dust in explosive atmospheres composed of a mixture of fire-damp and air. The experiments consisted in firing gunpowder into the ordinary air; into an inflammable mixture of mine gas, direct from Hebburn Colliery, and air; into ordinary air with coal dust in suspension, and into ordinary air with coal dust lying quiescent. The shots were fired into a specially prepared chamber, consisting of a cylindrical tube, 100 feet long and 3 feet in diameter, made of boiler plates. The tube had safety vents at intervals along the top, closed by wooden plugs loosely knocked in; and its far end was closed before commencing any experiment with a sheet of brown paper. In the experiment with common air, fired into by gunpowder alone, a bright flash was observed in the chamber; and the brown paper was blown off the end of the tube. When coal dust was present, without gas, either in suspension or quiescent, the flash was considerably brightened and lengthened; and not only was the brown paper blown off the end, but a huge cloud of smoke was propelled for more than 30 yards from the mouth of the chamber, and many of the plugs were forcibly projected from the safety vents, being followed by rushing jets of thick black smoke, and in some instances flame—suggestive of the explosiveness of the mixtures of coal dust and air. The force of the explosion of fire-damp and air was also well exhibited.

A Train Wrecked by a Tornado.

On the afternoon of Sept. 12, a west-bound passenger train on the Iron Mountain Railroad at Charleston, Mo., had just reached the city limits when the passengers and crew noticed the approach of a funnel-shaped cloud which was dealing destruction to everything in its path, uprooting trees and hurling missiles before it. The train and the tornado met, and the wind lifted the cars and landed them 20 feet from the track, almost turning them over. Two persons were killed, and 11 injured.

Aside from the wreck, the damage done by the tornado was slight. Its path was not over 30 yards wide, and it did not extend more than a mile.

Wave Power.

A correspondent from Maryville, Mo., who obtained the idea from a spouting rock in California similar to the spouting rock of Newport, suggests a plan for collecting and utilizing sea water for power. His idea is to excavate a conical tunnel in the rock or the building of such a tunnel in the sand, through which the waves may force water intermittently into an elevated reservoir; the pipe between the tunnel and the reservoir being provided with a check valve. The water stored in the reservoir could be utilized for power at pleasure.

A Day on the Fish Hawk.

BY CHARLES BARNARD.

When the first settlers came to this continent they found the rivers and the sea swarming with fish. There were shad and salmon in the rivers; herring and smelt filled every little creek; mackerel in immense schools rippled the waters of the bays; cod and halibut could be caught in boats off the shore, and oysters and lobsters were abundant everywhere. Now many of these fishes are very scarce or have totally disappeared. As more people came here, more fish were needed, and we caught them too fast. Then the fishermen began to be alarmed, and asked what it all meant. There was only one man who could explain the matter—the zoologist.

Now, the zoologist is modest, and he said, very plainly, "I do not know what is the matter, but I can find out. Give me a steamboat and I will study these fishes, and then I can tell you what you had better do about it." So it happened that the government built a steamboat and called it the Fish Hawk, and on this boat the zoologist has been at work for some time, and has learned more about the sea and sea-life than we ever knew before.

One bright summer morning, a few weeks ago, the Fish Hawk lay at the Lighthouse Dock, near Tompkinsville, Staten Island. As it was vacation time, a party of zoologists had been invited to spend a day on the boat, and see how the zoologist-in-chief studies the lives of fishes who live deep in the sea. So it was, also, that the zoological historian came to go, too. It was vacation for the visitors. On the Fish Hawk there is no vacation. The year round, it sails and sails, searching everywhere for new facts about fishes. Part of the time it is also busy hatching young fish. The work of this trip was to see how the zoologist gathers up fish-life from the floor of the ocean. We steamed out past Sandy Hook and steered away for the Lightship. By noon the big hotel on Long Beach could be seen ten miles to the north, and Sandy Hook Lightship lay about twelve miles to the west. Then we prepared for the strange work of the day.

To understand it all, we must examine the boat as a machine, or part of a machine, used by the zoologist in his curious studies. The Fish Hawk has two screws, so that it can be handled with the greatest precision, one or both of the engines being used to place the boat in any required position, or give it any required direction when in motion. The wheel-house is on the upper deck, forward, so that the boat can be controlled from a single point. The stout foremast is immediately in front of the wheel-house, and has a long pivoted boom like a derrick. At the foot of the mast is a steam hoisting engine, controlling a long steel cable. This cable is arranged like the hoisting rope of an ordinary derrick, except that the cable, before passing through the boom of the derrick, passes through a pulley attached to a powerful steel spring placed near the top of the mast. This spring is used to take up any sudden jerks or strains that may come on the hoisting cable when it is in use, and thus prevent it from breaking in sudden strains. This derrick and cable are the zoologist's fishing line and pole.

For a hook he uses a curious iron frame, shaped like the runners of a sledge. This is the mouth or open end of a huge woven net, and the whole apparatus is called a "beam trawl." The net attached to the frame when drawn out resembles a huge purse, the lower part ending in a point or little pocket. This end is open, but can be securely closed by tying it up with a rope. The zoologist uses this great net by dragging it over the bottom of the sea, the ship, the derrick, and the engines all working together to make its iron runners slide over the bottom of the water and scoop up whatever fish are in its way. Before we see the zoologist go a-fishing we must notice one more little machine. This is the sounding wire, for ascertaining the depth of the water. This is a fine steel wire wound on a spool and carrying at the end a brass weight or plummet, having a "grease cap," or little pocket for grease, at the end. Above this is placed a self-recording thermometer. This is arranged in such a way that, on letting a brass weight slip down the wire, the thermometer, when struck by the weight, records the temperature of the water wherever the glass may be.

The real work of handling the great net, or "dredging," as it is called, is performed by the officers and men of the boat. The zoologist's work comes afterward. So it happened that we all stood on the upper deck watching the performance. It was a curious sight. We were all alone on the sea, with only the dim, hazy Highlands visible to the west and the white steamer rolling lazily on the Atlantic waves. The engines had stopped, and the boat was drifting on the tide. The captain stood at the bows, with the second officer at his side. There was a man at the wheel waiting for his commands. There was an officer at the bells to control the engines, a man at the hoisting engine, a man at the sounding wire, and a dozen sailors standing ready by the big trawl. Below, the engineers and firemen were all in place, ready for their important though unseen work. An officer also stood ready, notebook in hand, to make a complete record of the work.

The man at the sounding wire began to turn his crank and wind in the wire. Then he reported that the water was thirteen and a half fathoms deep, and the little stones clinging to the grease showed the bottom to be gravelly. A word from the captain, and the hoisting engine began to turn, and the great iron-mouthed net rose in the air, the boom swung out on the water, and the net dropped out of sight in a ring of foam. The cable went singing and hissing through the green water, and in a moment it slackened up—the trawl had reached bottom, eighty feet under water. A rope fastened to an iron ring that slid along the cable was drawn tight by the sailors and made secure near the bow. This brought all the strain on the cable right down to the ship's nose, and caused the cable to act as an anchor chain. The boat swung slowly round, with her head to the wind. One engine was started astern, and the boat drifted slowly backward, dragging the great net over the bottom of the sea.

For ten minutes every man stood in his place in silence. The second officer watched the spring at the masthead. It was quivering and uneasy, now drawing out, now pulling back again, as the trawl struck a rock or stone heap on the bottom. The iron runners would lift it over fixed rocks, and smaller stones would be scooped up by the net. A man stood with his hand on the cable to ascertain by the feeling of the trembling wires whether it was sliding along easily or jumping and bumping over rocks. Every man stood watchful and anxious, for a big rock might catch the trawl, and every one must be ready to stop the boat and ease up the cable to prevent breakage. It was strange, fascinating work; but we could not stand watching it too long, for the zoologist called his guests to the main deck below.

Here the men of science found everything ready for their work. Hanging tables had been let down from the ceiling, and on these were soup plates and bowls filled with sea water. A wide door stood open at the side, just above the water. Then we heard the bell ring, and the boat stopped. Next we heard the rumble of the hoisting engine overhead, and a moment later the huge net was dangling in the air at the door. The end was hauled in on deck and opened, and out upon the deck poured a mass of stones, shells, and gravel, mingled with clams, crabs, both large and small, starfish, sea-urchins prickly with spines, sea-anemones, sponges, and fish of every kind and shape. A big flounder was picked up and sent to the ship's cook, and then the men of science gathered round the wet and wriggling heap and picked out the zoologic prizes. Every one engaged in the grand hunt for fish-life, turning the wet stones over in search of strange forms that dwell in the still, dark, mysterious place we call the floor of the sea. Millions of microscopic creatures that looked like bunches of brilliant color, golden browns and deep reds, rich greens and tawny oranges, were mingled through the flopping, crawling heap, and were quickly carried to the bowls, where they spread out like fairy plants in the clear water. Strange eggs and comic baby flounders, with their funny eyes all in the wrong place, and grinning skates flopped on the wet deck; but nobody seemed to care for common fishes. The search was for scarce and uncommon specimens or things that might be useful for study and investigation. One man wanted polyps for his museum; another wanted fish eggs for the study of embryology.

Meanwhile the steamer had steamed ahead for a mile, and the huge trawl was dropped again in the green water, and the boat drifted slowly backward, scooping up more treasures from the bottom. Four times the net was emptied on the deck and zoologic treasures were fished out of the tangled mass of shells and stones. Altogether over one hundred different kinds of fishes, shellfish, sponges, and other varieties of sea-life were counted, and the best examples were put in alcohol to be carried home to the museums.

This dredging was really in comparatively shoal water. The same trawl has often been used in water many hundreds of feet deep. In such deep sea dredgings strange, wonderful forms of fish-life are brought up from the eternal night that dwells under the Atlantic. The object of this trip of the Fish Hawk was to show to our little party of students and teachers of zoology how the United States Fish Commission studies the fish-life of our coast.

Naturally, it might be asked why the government keeps this expensive steamship in commission? Is it merely to let the zoologist poke about over the floor of the sea? That is precisely the point. Once we had abundant fisheries everywhere. Now fish are scarce and high. We give the zoologist a steamship and let him go fishing, because he is a man of science. He studies on this boat fish-life. He learns the secret of fish habits, their breeding times and places, their foods, and their enemies. He collects facts, and facts are money. Science deals with exact things—with things as they are. And from these facts he decides what is best for the fisherman to do. For instance, he learns that the smelt breeds in the early spring, and he says to the legislators, Pass a law forbidding any one to catch smelts in spring. Give the mother fish a chance to rear her family, and next year smelts will be plenty. You have been killing all the little mothers. It is no wonder the fish are scarce. He says that we must help the shad by artificial protection. We must raise millions of little fish, and then big fish will be plentiful again. The man of science maps out the floor of the sea, studies the supplies of fish food, studies the temperature of the water, points out in what seasons fish are plentiful. He studies fish-life that it may be more abundant and that we may not, as we have done in the past, waste the wonderful wealth that comes out of the sea.—The Outlook.

The Influence of Trifles.

Jefferson was fond of telling a story which illustrates in a forcible manner the importance that absurdly insignificant matters may sometimes assume. When the deliberative body that gave the world the Declaration of Independence was in session, its proceedings were conducted in a hall close to which was situated a livery stable. The weather was warm, and from the stable came swarms of flies that lighted on the legs of the honorable members, and, biting through the thin silk stockings then in fashion, gave infinite annoyance. It was no uncommon sight, said Jefferson, to see a member making a speech with a large handkerchief in hand, and pausing at every moment to thrash the flies from his thinly protected calves. The opinion of the body was not unanimous in favor of the document, and, under other circumstances, discussion might have been protracted for days, if not weeks; but the flies were intolerable. Efforts were made to find another hall, free from the pests, but in vain. As the weather became warmer the flies grew worse, and the flapping of handkerchiefs was heard all over the hall as an accompaniment to the voices of the speakers. In despair, at last some one suggested that matters be hurried so that the body might adjourn and get away from the flies. There were a few mild protests, but no one heeded them, the immortal declaration was hurriedly copied, and, with handkerchiefs in hand fighting flies as they came, the members hastened up to the table to sign the authentic copy and leave the flies in the lurch. Had it not been for the livery stable and its inmates, there is no telling when the document would have been completed, but it certainly would not have been signed on the Fourth of July.—New York Sun.

A New Electric Locomotive.

There is an electric locomotive in course of construction in Boston, Mass., which promises to meet all the requirements for propelling railroad trains. It is an eight horse-power machine and is unique. The distinctive feature of the invention, says the Boston Transcript, is the substitution of a piston and cylinder in place of the usual rotary power. The cylinder is much longer than for steam purposes, and has in its interior a series of magnets. The piston passes entirely through the cylinder, with crossheads at either end. On the piston within the cylinder is a series of armatures of peculiar construction.

On the axle of the driving wheels are commutators whose function is to apply and cut off the electric current, just as the eccentrics control the steam of a steam engine. The principle of the machine is the admission of the current to the magnets in the cylinder, which are in advance of the piston rod, and by their action on the armatures the piston rod is moved forward. As the stroke is ended the current is cut off from the magnets first charged and applied to those at the rear of the piston, giving it a reverse motion, thus maintaining a strong, regular motion. There is absolutely no back pressure from the electric current, while in a rotary motor this is estimated at 20 per cent of the force applied.

It is practicable to run the machine at 200 revolutions of the axle per minute, and with a driving wheel 8½ feet in diameter, and the crank pin 3 feet from the center, there would be a 6 foot stroke under a full head of power. The machine is adapted to receive the electric current either by a trolley wire, a third rail in the track or from a storage battery.—Street Railway News.

Cramps in the Legs.

Unschuld calls attention to an early symptom of diabetes, which is seldom mentioned by writers on the subject but which is yet frequently found, and may assist in an early diagnosis of the affection. This symptom consists in cramps in the calves of the legs, and is found in about twenty-six per cent of all cases. The pains occur with especial frequence in the morning upon waking, and occasionally also during the night, when they are usually accompanied by a desire to urinate. They are rarely troublesome in the daytime, unless after a nap or a bath. Cramps of this nature, occurring in a person in feeble health, should always, Unschuld holds, suggest the necessity of an examination for sugar.—Med. Record.

THE TRAINING OF ZEBRAS.

Some time ago, there appeared in the Revue des Sciences Naturelles Appliquées a note upon the training of zebras, and which read as follows: "An attempt has several times been made, with more or less success, to tame adult zebras. A merchant of the Transvaal, a short time ago, bought eight of these animals, still young, that had been lassooed two months previously. At the end of a couple of months, two of them had been thoroughly broken in as draught animals. In their gait was combined both strength and sureness." This note was signed "S.," and was immediately followed by these few lines added by the editor: "It is not without interest to recall that the training of the Burchell zebra (Zebra Burchelli) has been accomplished at the Jardin Zoologique d'Acclimatation. These zebras did the hauling work of the zoological establishment of the Bois de Boulogne for several consecutive years, and worked daily in the interior service."

By what means is the zebra trained? It would be interesting to make some researches into this subject, and that is the object of the present article.

We shall say in the first place that there are zebras and zebras. In fact, there are three species of zebras, which are principally distinguished by their coat and which are somewhat different in character. All three belong to Southern Africa.

The zebras, says Brehm, stand midway, by their carriage, between the horse and the ass. They have a thickset body, a strong neck, the head of both the horse and the ass, quite long and wide ears, a straight mane, with hair that is not so coarse and thick as that of the horse and not so soft and flexible as that of the ass. Their tail is tufted at the extremity and their hoofs are oval in front and rectangular behind. The coat of all the species known is in great part striped.

The zebra properly so-called (Hippotigris zebra) has the entire body striped, inclusive of the legs. It lives in the mountains of Southern and Eastern Africa, from the Cape as far as to Abyssinia.

The dauw (H. Burchelli) has a strongly striped head and body, but the legs are uniformly white. It lives upon the plains of Southern Africa and ascends to the steppes comprised between the tenth and twelfth degree of north latitude.

The quagga (H. quaccha) is the species of which the coat is least striped. The rump, thighs, belly and legs are not striped, and it is the species that most nearly approaches the horse. It inhabits the plains of Southern Africa, but does not ascend so far toward the north as the dauw.

The zebra properly so called is the one that possesses the most intractable disposition, and the one that has long been considered as untamable. The museum of Paris, nevertheless, once owned a female of this species that had been captured when young, and that had belonged to the governor of the Cape. It was very gentle and allowed itself to be approached, led and mounted.

According to Brehm, the quagga is the species that allows itself to be tamed most easily. At the Cape, says he, it is often seen in company with draught horses, and in England Sheriff Parkins had a pair that could be harnessed to a small carriage: yet Cuvier speaks of a quagga that was owned by the museum and that remained wild and untamable.

The dauw also is easily tamed, and the young born in captivity can especially be trained without much difficulty.

It is usually a question of this when we speak of trained zebras.

The processes employed for training zebras are the same as those in use for horses, and the experiments made at the Jardin d'Acclimatation have demonstrated that gentle methods succeed better than harsh ones and than the true breaking-in process. This was shown by Mr. Saint-Yves Menard, then sub-superintendent of the Jardin d'Acclimatation, in a communication upon the subject made to the Societe d'Acclimatation in April, 1874.

The effort was first made to familiarize the dauws by treating them as horses, and not as menagerie animals that are fed and then left to themselves. Halters were carefully put upon the animals, and then they were tied in stalls alongside of one another and separated by simple partitions.

The idea afterward occurred to interpose horses between the zebras, and, by putting to profit the instinct of imitation that all the equidæ possess, one succeeded in grooming them, as they had seen the operation performed upon horses without the latter offering any resistance; and it is undeniable, as Mr. Menard says, that an animal scarcely tamed gradually assumes confidence at the approach of man when it sees its neighbor reassured.

The dauws thus showed themselves more familiar every day. They were so calm that no stable accident occurred, and allowed themselves to be groomed regularly, with the brush and currycomb. After these results were obtained they were set at liberty now and then upon a lawn surrounded with a wire fence, and quickly learned to know the way to it and how to return to their stalls.

Nothing further was done for five months. It was but little in appearance, says Mr. Menard, but it was much for us who could appreciate the daily progress of familiarization, and who know all the importance of it. A few premature experiments in harnessing taught us, moreover, that training ought not to be begun before their complete taming. On the contrary, the sequel demonstrated to us that, this first result obtained, each dauw in turn very readily submitted to training. Gentleness and patience were powerful means, while force and brutality could only retard us.

Six months after the arrival of the dauws, it was considered possible to begin experiments in harnessing, and for this purpose two females that seemed to be the most gentle were selected. They had already been prepared for it by being harnessed up in the stable. They had been habituated to wearing a small saddle, a collar and then a bridle, and afterward to receiving a complete double draught harness. They made a resistance at first by leaps and sudden motions, and tried to bite when the bridle was put upon them, but thanks to the vicinage of the horses, they were triumphed over.

ZEBRAS HARNESSED THREE ABREAST.

Once accustomed to the wearing of harness, they were led out into the garden one by one with the harness upon their back. What was curious was that it was difficult even for two men to hold them by the lunge. They had not yet complete confidence, while their ordinary keeper could easily, by himself alone, hold them in check in making them walk before him. He soon walked them in this way in pairs, and accustomed them to walk side by side as in double harness, to feel the bit and to allow themselves to be driven.

Nothing was simpler afterward than to complete the harnessing. A light break was wheeled up behind the animals, and by directing the pole with caution it was possible to fix the traces, etc. This was not very well done in the first place, but the thing became easy after the animals had got accustomed to the two or three assistants employed. It necessitated flat straps to prevent plunging, but nothing more, for plunging was the sole opposition offered by the animals, which were neither restive nor timorous, and which pulled quite regularly.

One turn of the garden was made at first, and afterward two, three and more circuits. Then one went into the alleys of the Bois de Boulogne, into the Avenue Neuilly crowded with carriages, and finally into the streets of Paris. After several exercises in walking, the zebras were put to the trot. Finally, at the end of three months' training, they made a trip from the garden to Place de la Concorde on a trot.

A few months later on, and always by the same means, one succeeded promptly in getting useful work out of the three subjects, which finally took rank with the best animals of service in the Jardin d'Acclimatation. They were harnessed to the dirt cart and were employed regularly every day in hauling earth and manure into the interior of the garden, and they even drew heavy loads from the Batignolles Station, provided they were always harnessed and driven by the same gentle and patient men.

It became likewise easy to shoe them by means of the trave, a well-known apparatus of farriers and veterinary surgeons, and very useful in the shoeing of or operating upon vicious horses.

Thus, it may be said that it is quite easy to train the zebra through gentleness. It is possible to succeed in harnessing them two and three abreast (see figure), but no other means gives the same results, and this fact was proved at the time that the dauws under consideration were trained at the Jardin d'Acclimatation.

A very skillful horse trainer, Mr. C., proposed to Mr. Geoffroy Saint Hilaire to take three of the zebras in question and put them in harness and train them. His services were accepted without the directors of the garden giving up their own experiments; and three animals were confided to him in January, 1873. He was to receive a fixed amount upon the day that he should drive two dauws harnessed to a break, on a sustained trot, without a stop or gallop, from the Jardin d'Acclimatation to Place de la Concorde, and then, after a rest, from Place de la Concorde to the Jardin.

It never became necessary to pay him the award, but the experiment was none the less interesting and permitted of comparing the means employed at the garden with opposite ones. Mr. C. had received the dauws in good condition, well fed, vigorous and incompletely tamed. In order to submit them to training immediately, he had to fight them. Instead of inspiring confidence, he made himself feared. Acting by means of contention, he had recourse to weakening by diet or insufficient food.

With a two-wheeled cart he made prisoners two dauws in three shafts and then three dauws in four shafts, so that one of the animals desiring to struggle or free himself was held by the others. Moreover, he drove them brutally, in speaking to them in a severe tone and whipping them vigorously.

Briefly, at the end of four months and a half he had obtained but a mediocre result. After attempting to harness two of the animals to the break, he gave up the idea of obtaining his award, and returned to the garden three fatigued, impoverished animals, less familiar perhaps, and not in a state to be utilized. It took one of them more than eight months to regain its normal plumpness.

However, Mr. C. had shown to what point man can submit dauws to his influence. He had conquered the animals rather than tamed them, but it is none the less true that at the end of four days he had been able to present one of them led by the bridle. He had even submitted these animals to exercises at liberty in a riding school.

It must be remarked, says Mr. Menard, after the account of the training that has just been read, that in such a case influence ceases with the man who has exercised it and is not transmitted. When the Jardin d'Acclimatation took back the animals that had been intrusted to Mr. C. it required some time to familiarize them anew with their guardian.

On the contrary, these same animals, treated with gentleness, readily allow of the substitution of one driver for another, as those trained at the garden with kindness have proved.

Thus, then, upon the whole, the basis of the training of wild animals, as well as of domestic ones, is gentleness combined with patience and, of course, firmness.—La Nature.

A Curious Potato.

A correspondent from Somerset, Pa., Mr. W. M. Schrock, sends us a specimen of a last year's garnet potato, which, having sprouted, potatoes grew on the parent potato. On each side of the original potato are slits, from which protrude the new growths. On removing one of these other potatoes, others are seen in the heart of the original.

Photographing the Moon at Lick Observatory.

The great telescope of the Lick Observatory is not only a powerful instrument for seeing the heavenly bodies, but it is also a powerful camera for photographing them. The object-glass is three feet in aperture, and it was, until very recently, the largest in existence. A supplementary lens, thirty-three inches in diameter, is provided, which can be attached to the telescope just in front of the thirty-six inch lens. When it is so attached, the combination becomes a great photographic camera—the largest in the world—which is especially suited to do certain classes of work. One of the things which it is particularly well fitted to do is to photograph the moon, and for the past few years considerable time has been devoted to making negatives of the moon during the course of a lunation—from new to full moon. As the shadows on the moon change materially during a few hours, it has been necessary to make a set of such pictures every hour or so, and the whole series gives a very perfect representation of the lunar topography as it is now. By comparing these photographs with others previously made (Rutherfurd, Draper, De la Rue), and more especially with photographs which will be made in the future, it will be easy to detect any important changes which occur in the lunar surface. It is certain such changes must occur, since gravity is constantly working on the moon, as on the earth, to pull down existing structures; and it is to the study of changes that we have to look for a more intimate knowledge of lunar conditions. An accurate plastic representation of the moon's surface is a prerequisite for such a study, and it will be seen that the photographs of the Lick Observatory, when properly examined, afford every desired datum. Most of the photographs made by previous astronomers were on too small a scale and were not precise enough in definition to afford the necessary accuracy. The enlargements from our negatives meet every want, and enable us to construct a satisfactory map of the moon on a scale of ten feet to the moon's diameter. One inch on such a map corresponds to about seventeen miles, or one seventeenth of an inch to one mile. A map of California on this scale would be about forty-one inches long.

The original negatives made in the focus of the large telescope are a little over five inches in diameter. They are extremely beautiful as mere pictures, especially when copied as transparencies on glass. Everything that the telescope will show is contained in these originals, but the scale is still so small that minor features cannot be distinguished. A mile on the moon is only a few thousandths of an inch on the negative, for example. Hence they must be enlarged to be of use. Without enlargement they are of small scientific value. —Dr. Edward S. Holden, in McClure's Magazine for October.

A New System of Medical Treatment.

We all know what homeopathy and allopathy and hydropathy are, but probably few know what the new "pathy," isopathy, is. The word is applied to the medical treatment of diseases of the several organs of the body by the corresponding organs, or preferably extracts of them, of animals. Thus diseases of the brain would be treated by an extract of the healthy brain of an animal, such as an ox; diseases of the spinal cord by an extract of the spinal cord of some animal, and diseases of the heart by an extract of the heart of an animal. While the system is comparatively new to modern scientists, it actually is "as old as the hills." Two thousand years ago it was hinted at by Hippocrates, was mentioned by medical writers in the middle ages and was described at length fifty years ago by a German physician named Hermann. The system died out and attracted little or no notice until about two years since, when it was revived by Dr. William A. Hammond, a celebrated physician of Washington, D. C., Surgeon-General of the United States Army. By a long-continued maceration of the brain, the heart, the spinal cord, etc., for a year or more, by processes that have been fully described in medical journals, principles contained in these organs, but in an inert form, are extracted and modified in a manner similar to that effected within the human body.

These principles are rendered practically indestructible by time. Dr. Hammond says that organic beings possess the power of assimilating from the nutritious matters which they absorb the peculiar pabulum which each organ demands for its development and sustenance. The human body, as well as the body of any animal, makes no mistake in such selection. The brain absorbs such principles as are necessary to sustain its strength; so do the heart, the liver, the muscles, etc. In certain diseased conditions these organs lose the power of selecting the principles which they need, and sickness and sometimes death ensues. The object of the administering of all medicines is to hold disease in check while nature effects a cure. Medicines in themselves cannot cure. Nature alone can do this. The principle of isopathy, therefore, differs from that of other "schools" essentially in the manner in which the remedies are to be introduced into the physical tissues requiring them. The established schools introduce the medicines generally through the stomach, thus requiring more or less time for their active principles to be assimilated with the organs affected. In isopathy the remedies are brought into immediate contact and assimilation with the organ, without being required to pass through the digestive system. This is the main difference, though there also is a difference in the character of the materia medica. It is by the direct injection into the blood of the peculiar matter that an organ requires that isopathists hope to do away with the performance of many vital processes which now are accomplished only by the expenditure of a greater or less amount of vital force.

As an illustration, suppose a person to be suffering from an exhausted brain brought on by overwork. No matter how judiciously the patient attempts to live up to the rules of health, the condition continues. If the concentrated extract of the brain of a healthy animal be injected into the blood of the patient, the pabulum which the organ requires is at once supplied. This rule is applicable to every other organ. Just what success will attend the workings of the new system is conjectural. It is claimed that as far as it has been tried it has been followed by a surprising amount of success. The new system, if it eventually prove to be as great a success as at present indicated, will not interfere with the established schools of medicine. It will be an aid to all and may be adopted by the homeopath and the allopath alike without the abandonment of any of the fundamental principles so dear to the adherents of the different schools.—Troy (N. Y.) Press.

Penny-in-the-Slot Gas Meter.

This is a gas meter in which automatic vending mechanism is used, so that a user of gas may purchase a certain amount of gas by simply placing a coin in a receiver, which is so connected to the meter as to allow a certain number of feet of gas to be used for a given amount. For instance, the apparatus is arranged to receive silver quarter dollars, and is so connected to the meter mechanism that, if the gas is selling at $1.25 a thousand cubic feet, the mechanism would be so timed that upon the insertion of the quarter dollar, 200 feet of gas could be used before the mechanism of the meter would be stopped; five quarters can be fed into the apparatus, so that $1.25 worth of gas, or 1,000 feet, can be paid for at one time. By this means a person can pay for gas in small installments, rather than wait until the sum accumulates.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

REFRIGERATOR CAR.—Charles S. Hardy, San Diego, Cal. This invention provides means for supporting ice, the devices being adapted to fold out of the way in the car when not in use. The ice box is formed of folding hinged members, a drain guard below the box swinging into and out of position for use. The parts fold and unfold in a simple and secure manner, and provision is made to prevent the drippings from soiling the contents of the car, and to avoid the clogging of the drain pipe, while the whole apparatus is designed to promote economy in the use of ice.

SWITCH.—Charles L. Lincoln, Brooklyn, N. Y. To hold the switch point or rail steadily in position without actually locking it, and in a convenient and easy manner, is the object of this invention. The switch rail is also so arranged, in reference to the car track, that it will lie normally in closed position, and when opened by mechanism on the car will be automatically shifted back by contact with the car wheels. The switch rail has a rearwardly extending ribbed tail piece, and a contact block is held to slide at right angles to one of the siding rails, there being a lever connection between the contact block and the tail piece whereby the pressing out of the block actuates the tail piece and moves the switch rail.

SWITCH WORKING MECHANISM.—This is a further patent of the same inventor, for a mechanism carried by and operated from the car, whereby the switch may be opened or closed at will by turning a crank and operating a treadle on a moving car. Beneath the car platform are vertically swinging levers carrying shifting devices, pivoted hangers supporting the levers and a cross bar connecting the hangers, while on the car is mounted a crank shaft having operative connection with the cross bar.

CAR FENDER.—William L. Shockley, Colorado Springs, Col. This fender is held beneath the forward end of the car and the car platform, and is normally supported so as to pass freely over any ordinary obstruction on the track, but it may be instantly released and caused to spring downward into close contact with the track, even though the car is running very fast. The fender itself is a sort of flat, skeleton scoop, having side straps, and the mechanism by means of which it is held up or thrown down on the track is of a simple and inexpensive character, readily operated from the car platform.

CAR BRAKE.—John C. Miner, Smyrna, Neb. This invention dispenses with the use of brake beams, and provides a simple mechanism for setting the brakes quickly and firmly against the wheels, while at the same time track brakes are forced down upon the rails to slightly lift the truck and prevent the wheels from sliding. Vertically movable racks, operated by a lever and gear mechanism, are carried by the car truck, and brake shoes carried by a portion of the racks engage the car wheels, while a second set of brake shoes carried by the other racks are adapted to engage the track rails.

Electrical.

TELEGRAPH KEY AND SOUNDER.—Philip D. Cox, Jasper, Fla. This invention provides an extremely simple and efficient instrument in which the key is pivoted on a threaded stud whose lower end screws into the base to which are attached the sounder and magnet, the stud extending through a hole in the key, above and below which are nuts, a spring resting on the lower nut and pressing the under surface of the key.

FRICTION BRAKE.—Bergen Davis, Newark, N. J. This device consists of a magnetized drum with a periphery composed of pole pieces separated from one another by a diamagnetic material, electro-magnets connected with the pole pieces having consecutive pole pieces of opposite polarity, while a metallic strap or shoe is held for attraction to and frictional engagement with the drum. The amount of braking effect, from a gentle friction up to locking the wheels, is controlled by a rheostat on the platform of the car.

CONDUIT FOR ELECTRIC RAILWAYS.—Michelangelo Cattori, Rome, Italy. Combined with corresponding adjacent sections of each of the conductors is a rotatable circuit closer having a surface partly of insulating and partly of conducting material, with stationary contact pieces adapted for continuous sliding contact with the surface of the circuit closer, the contact pieces and the insulating and conducting portions of the circuit closer being so arranged that the adjacent sections of one conductor are connected when the corresponding sections of the other conductor are disconnected. A high degree of safety is thus assured and sparking is avoided, while one or both rails of an existing track may be utilized as conductors.

Agricultural.

DISK CULTIVATOR.—Andrew L. Brock, Lockhart, Tex. This machine may be used with or without supporting wheels, and in operation cuts stalks or trash while cultivating the ground. The disks are substantially cup-shaped, and turn in brackets or hangers, each disk frame carrying a disk cultivator at each end, the disks being adjustably connected with their frames and also with the main frame of the machine. The disks may be set in any desired position to throw the dirt to or from the rows, and may be carried close together or farther apart to regulate the width of the strip to be cultivated.

Miscellaneous.

RAISING SUNKEN VESSELS.—Edward M. Arnold, Pawtucket, R. I. According to this invention a vessel employing the improvement has a short chain cable firmly attached to it about amidship, there being a strong button on the end of the chain, and attached to the button is a coil of rope at the end of which is a float or buoy, the latter rising to the surface when the vessel sinks and indicating the locality. A specially devised grapple is employed to send down the rope to which the buoy is attached, the grapple sliding over and engaging the button, when the hawser, to which the grapple is attached, may be drawn upon and a firm connection established with the sunken vessel, to be afterward raised by the ordinary means.

CREVASSE CLOSER.—Mathias A. Laska, New Orleans, La. For closing breaks in dams, etc., this invention provides for the pivotal connection of an arm with one of the posts already driven into the ground, and for its detachable connection with one of the posts to be driven, the arm being adapted to carry the post down into the water and hold and guide it into position, permitting of properly driving the post from above. A skeleton frame is also provided to pass between adjacent posts, cross bars projecting at the ends to rest on the front faces of the posts to hold the frame in place.

PUMP.—Charles Rumley, Helena, Mont. This is an improvement on a formerly patented invention of the same inventor, providing a powerful pump of simple construction, but with a valve of less surface motion, and a spur cut-off, which, in connection with the valve, absolutely prevents leakage. There is no intricate mechanism in the pump to become clogged, so that it may be used to pump water filled with mud, sand, etc., and it may be worked in either direction, its ports being used alternately as suction or discharge ports, according to the movement of the pump piston.

PUMP VALVE.—Truckson S. La France, Elmira, N. Y. To prevent the valve packing from being forced into the throat of the port is the main object of this invention, which provides a simple form of construction especially designed for the valves of steam fire engine pumps. The valve seat has an outer bearing and a central bearing on which is a pad or cushion, and fitted to the outer bearing is the valve proper, under which is a supporting plate arranged to abut against the cushion of the central bearing when the valve is closed, the supporting plate being formed to nearly fill the port or valve space when the valve is closed. The packing or valve proper is thus relieved of pressure, and a thinner or weaker rubber may be employed without danger of its breaking down.

LATCH AND LOCK.—John MacLachlan, West Hoboken, N. J. A tubular case, consisting of two semi-cylindrical sections, receives and supports in working condition the improved latching and locking devices designed by this inventor, in very compact, simple, and cheap form, quickly applicable to any door of moderate thickness, the improvement affording an excellent knob latch and lock combined, or a latching device alone, if this is preferred. A lock of this kind may be conveniently adapted for the use of different keys.

GRATE.—Lee R. Andrews, Bath Beach, N. Y. This grate consists of a series of revoluble cylindrical grate bars, strips forming bearings for the shafts of the bars, which are connected by gear wheels with each other. A perforated hood is removably held on one of the strips to cover the gear wheels, the hood having dovetail parts engaging grooves in the bearings of the shafts to lock the latter in place on the strips. The improvement gives the operator complete control of the burning fuel, permitting of conveniently raking it and removing clinkers.

WIRE SUPPORT FOR BEDS OR SEATS.—Gustav Dominick, Cologne, Germany. This invention provides, within a suitable frame, two series of springs running crosswise of each other and essentially parallel to the sides of the frame, the springs of one series being fastened to the frame at both ends, while the springs of the other series are secured at one end only, the other ends being guided in eyes formed preferably by twisting the springs of the first series into coils. The springs of the two series supplement each other in their action, each series yielding to a certain extent, and a mattress made of springs so arranged yielding to the slightest pressure.

CLEANING MACHINE.—William Hebb, Cambridge, Vt. This is a machine especially designed for cleaning pails, tubs and similar vessels. It has a platform with standards in which vertically moves a slide adapted to be raised and lowered to move the brushes into and out of the pail or other vessel to be cleaned, a shaft journaled in the slide carrying a crank arm, by which, through a bevel gear connection, the heads carrying the brushes are revolved. The vessel to be cleaned is locked in position by a clamping and centering device.

CHOCOLATE DIPPER.—Cyprien Gousset, New York City. This is a device to be used for dipping cream drops into a chocolate solution to give them the desired exterior coating. It consists of an open frame crossed by parallel wires, a series of cups formed of serpentine or zigzag wires crossing the frame and resting at their upward bends upon the cross wires, while a second series of serpentine zigzag wires at right angles to the first series have their downward bends crossing the downward bends of the first series. It is adapted to carry a large quantity of cream drops and hold them so they cannot be displaced until perfectly coated.

FOOD SCREEN.—John H. Rhoads and Gustave H. Spannagel, Nokomis, Ill. This is a cheap and simple screen to be placed upon a table to cover the food and all else on the table. The screen frame which holds up the screen may be easily knocked down and snugly packed. It consists of a horizontal base frame, open at one end, arched bars pivotally connected therewith, and a longitudinal rod connecting the arched bars at the top of the arch, locking bars securing the frame in position to hold up the screen.

TEETHING RING.—Martin L. Metzger, New York City. This invention provides for the connection of an unbroken ring with a rubber nipple in a simple and inexpensive manner, whereby the ring will be very durable. The stem is bent upon itself to form two opposing members, a transverse aperture in the lower bent portion receiving the ring, to insert which the opposing members are sprung apart and the ring forced down to its socket.

CIGAR PACKAGE.—Samuel Roman, Montreal, Canada. This package is preferably triangu-

lar, in which shape the cigars are held by a practically rigid frame or band, which holds them in this position whether in or out of the box. The latter is triangular in form and has a base plate and one fixed end piece, the other end piece and two side pieces being hinged. A clasp holds the box closed, and by releasing it, one of the end pieces and the two side pieces may be let down and the cigars well exhibited.

DESIGN FOR A COLUMN.—Amos A. Fenn, Leavenworth, Kansas. This column is angular in form, with plane ends, intermediate of which the several faces have a special style of ornamental configuration.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

ALLEN'S NATURALIST'S LIBRARY. Edited by R. Bowdler Sharpe. (A) A HANDBOOK TO THE MARSUPIALIA AND MONOTREMATA. By Richard Lydekker. (B) A HANDBOOK TO THE BIRDS OF GREAT BRITAIN. By R. Bowdler Sharpe. London: W. H. Allen & Co., Limited. 1894. Pp xvii, 302, and pp. xix, 342. Price $2.40 each.

These beautiful volumes, the illustrations all being in colors and exceedingly numerous, cannot be adequately reviewed by us. The one on birds contains over thirty beautiful plates relating to ornithology and oology. The one on marsupials and monotremes, treating of the curious animals of Australia and their relatives in other parts of the world, has thirty-eight plates of the same description. The illustrations of the kangaroo and the wallaby alone will be found of especial interest. There are other volumes to follow, and a most valuable series will be the result. The volumes remind us of the old time and widely popular "Naturalist's Library," to which it is a worthy successor.

WATER OR HYDRAULIC MOTORS. By Philip R. Bjorling. London: E. & F. N. Spon. New York: Spon & Chamberlain. 1894. Pp. xii, 287. With 208 illustrations. Price $3.50.

The different types of hydraulic motors, from the old fashioned water wheel to the modern turbine, reciprocating and oscillating engines and hydraulic rams, are the subject of this work, which not only describes these different classes of machines with adequate illustrations, but treats of measurement of water and of general hydraulics. It has an excellent table of contents, both of the matter and the illustrations, and an index.

MECHANICAL DRAWING. Projection Drawing; Isometric and Oblique Drawing. Working Drawings. A condensed text for class room use. By Walter K. Palmer. Columbus, Ohio: Charles B. Palmer. Price 80 cents.

When a young man finds that he can draw, he is apt to consider himself a draughtsman, while he may be ignorant of the manipulation of instruments and appliances. There are definite mathematics in drawing, and this little work, designed for the use of teachers, develops the fundamental points which should be understood by a draughtsman, some of which are, doubtless, comparatively little studied.

TAN PILE JIM; OR, A YANKEE WAIF AMONG THE BLUENOSES. By B. Freeman Ashley. Chicago: Laird & Lee. Pp. 259. Illustrated. Price cloth, $1; boards, 50 cents.

This prettily printed and illustrated book gives a picture of life in the British provinces. The author evidently is of a humorous bent, and by means of numerous illustrations the text is fully illustrated.

THE WORK OF HERTZ AND SOME OF HIS SUCCESSORS. Being the Substance of a Lecture delivered at the Royal Institution. By Professor Oliver Lodge. London: The Electrician Printing and Publishing Company, Limited. Pp. 58. No contents, no index. Price $1.

We are glad to find the classical researches of Hertz put into book form. The matter is largely experimental and is elaborately illustrated, so that it will be of more popular interest than the dry statement of the work otherwise would be. Unfortunately, it lacks both index and contents, either of which would add materially to its value.

ALTERNATING CURRENT WIRING AND DISTRIBUTION. By William Le Roy Emmet. New York: The Electrical Engineer. 1894. Pp. 76. No index. Price $1.

We are very glad to see this little work. It will help electricians to recognize the fact that there is more concerned in the distribution of alternating currents of electricity than Ohm's law. The short table of contents of the book gives an excellent idea of its range of topics. The omission of an index is, of course, something to be regretted.

ELECTROMAGNETIC THEORY. By Oliver Heaviside. Vol. I. London: The Electrician Printing and Publishing Company, Limited. 1893. Pp. xxi, 466. Price $5.

Mr. Heaviside has won a fine reputation by his mathematical work on the theory and application of electricity. The title of this book states that it is on the electromagnetic theory. The preface indicates that the author has a pretty good knowledge of human nature and appreciates, to say the least, his own value. His plea for the recognition and correct statement of electrical units is excellently put and makes really amusing reading. The esprit of the author may be deduced from the title of one of the sections on "the nature of antimathematicians," the introduction being divided into sections. His plea for mathematics is most amusingly and graphically put. We strongly recommend the book to aspiring electricians, and hope that it will induce many to take up the mathematics of the subject who otherwise would be content with its general treatment.

PHYSICAL LABORATORY MANUAL FOR USE IN SCHOOLS AND COLLEGES. By H. N. Chute. Boston, U. S. A.: D. C. Heath & Co. 1894. Pp. xvii, 213. Price 80 cents.

Harvard University has led the way in requiring of its applicants for admission the execution of a course of practical physics as one of its alternatives. This excellent little book describes such a course. Numerous illustrations are given, and the different topics in physics are excellently treated.

PRACTICAL WORK IN GENERAL PHYSICS. For use in schools and colleges. By W. G. Woollcombe. Oxford: At the Clarendon Press. 1894. Pp. xii, 83. Price 75 cents.

We have in this volume another of the works on physical experiment, in which is covered the elementary or initial portions of physics. The book takes the form of a description of experiments, and some fifty different examples are given and elucidated as to their performance.

TWO OF A TRADE. By Martha McCulloch Williams. New York: J. Selwin Tait & Sons. 1894. Pp. 206. Price, cloth, $1.

☞Any of the above books may be purchased through this office. Send for new book catalogue just published. MUNN & Co., 361 Broadway, New York.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(6266) J. H. J., Shanghai, China, writes: Will you please tell me through the columns of the SCIENTIFIC AMERICAN how the rule for ascertaining the fall of the earth's surface for any given distance is obtained? The rule I believe is as follows: For the first mile a fall of eight inches; for other distances, multiply by the square of the distance in miles. A. The rule as stated by our correspondent is an approximate one only, and is derived from the formula of the United States engineers, viz., square of the distance in feet divided by the earth's equatorial diameter in feet equals the amount of curvature in feet. This being for curvature alone, a correction for refraction must be made, making the formula $(1-2m)\frac{D^2}{2R}$ in which D=distance in feet, 2 R= twice the earth's radius in feet, and m=0·075 in feet.

(6267) F. M., Kansas, writes: I am desirous of digging a well. I have already made three attempts and failed in each case. The circumstances are these. At the depth of about 17 feet there is a 6 foot layer of sand and gravel, the first two feet of which appears to be quicksand, the remaining 4 feet coarse sand and gravel, after which comes blue clay. We attempted to drive a wooden curb as we dug, but as fast as we removed the sand inside the curb it would fill in from underneath. The water also bothered considerably; we tried pumping it out, but after an hour's pumping, the sand would wear the leathers in the pump, so that it would cease to act, and as before stated, we had to abandon the attempt. Some parties advise me to have a brick and cement wall built on a circular wooden frame, the same to be sunk as sand is removed, but I cannot see why this should prevent sand coming in underneath any better than the wooden curb. Also how can the water be kept out of the way while removing the sand? Advice on the above matter will be greatly appreciated. A. An oak cage curb is the proper guard for protecting the operation of laying the foundation of your stone curb. This may be made of a ring of oak plank cut in segments and lapped to complete two layers for stiffness, also a narrow ring of pine for the top, to be removed when the stone curb reaches it in building. On the outside nail 1½ inch oak strips 5 or 6 feet long, according to depth it is desired to sink the curb below the water line, the strips nearly touching each other to make a strong but not tight curb. Place the wooden curb at the bottom on the water line and build up the stone curb, resting upon the bottom wooden ring as tight as possible without cement and so that the stone work will form a resisting arch circularly against the earth pressure, care being taken to protect the well from an earth cave from the water line to the top by braced sheeting of boards. When the stone curb is finished to the top ring, the work of excavating may be done by shovel as far as the water will allow without pumping. A large sand auger should then be used to continue the taking out of the sand evenly all around the inner edge of the curb to allow it to settle level. Any disposition to tilt may be counteracted by excavating at the high side only. No water should be taken out other than contained in the sand in the auger. A sand auger may be made by any sheet iron worker, from No. 16 iron, by making a cylinder about 9 inches in diameter and no higher than 9 inches, as that is about the depth of sand that can be taken in at one operation. The bottom of the cylinder to be fitted with lips like an auger, but extending around and just overlapping, with an opening from the center to a depth of one inch at the outer part. A strong forked iron stem about 6 feet long with an eye at the top for a wooden handle will complete the auger. Then by screwing the auger into the sand, with a little manipulation like handling a post auger, which by the way will make a good sand auger with a sheet iron guard pipe to keep the sand from washing off. In this way of excavating without removing the water the curb may be settled down to the desired depth. After arriving at the layer of coarse sand, if the curb sticks by the packing of the sand, a pole or rod of iron may be thrust under the lower edge of the curb ring to loosen it, or by removing the upper cage ring the stone curb may be carried up to increase the weight. In this manner by careful management substantial well curbs may be sunk to considerable depth in water-bearing quicksands and gravel.

(6268) N. C. F. asks: Will you kindly give me the true explanation of the reason why a sheet iron heater placed over a kerosene lamp will heat a room better than the lamp will without the heater over it, and why the same flame inside of a sheet iron drum in the form of a gas stove will give more heat than the same flame without a stove over it? A. There is no absolute increase of heat or of heat units by the use of the iron drums as stated; but there is something in the susceptibility of the nerves to the effect of low radiant heat from enlarged metal surfaces, nor is the phenomenon confined to metal alone, as attested in our boyhood, when we enjoyed the low radiant heat from the sunny side of a barn in the cool autumn weather. The radiant heat from the lamp diverges in all directions, and only the area of the body intercepts it, while the extended surface of a sheet iron drum intercepts and converts the entire divergent radiant heat into convergent radiant heat from a large surface, and its effect upon the nerves is to make us feel warm without an actual increase of heat energy from the lamp.

(6269) A. P. H. S. asks for a formula for treating wood patterns to give them the smooth black appearance. I have tried a number of paints and pigments, but thus far have been unable to find anything that will answer. A. Stir refined lampblack into brown shellac varnish until it contains enough of the pigment to cover well. Strain through cotton cloth. Apply two coats. After the first coat is dry rub down with fine sand paper or with emery paper. After the second coat is dry rub with hair cloth or a bunch of horse hair, and finally apply a thin coat of brown shellac with a camel's hair brush.

(6270) L. H. E., Kansas, says: On September 20, at 6:30 o'clock in the morning, the sun shines in a tunnel, or if you were to stand at one end and look through you could see the sun at the day and hour mentioned. What is the per cent of the grade of the tunnel and how do you get it? A. On Sept mber 20 the sun is on or near the equatorial plane, and for the assumed latitude of 40° north the sun's path is inclined 50° from the plane of the horizon at sunrise. At that date it rises about 14 minutes before 6, which added to the time of observation, makes it 44 minutes on its course from the horizon. Then 44′ × by the cosine of the latitude=33·7′, the vertical altitude. As 4 time minutes are equal to 1 degree $\frac{33·7'}{4}$=8·42 degrees, to which should be added 0·11° for refraction at that altitude, making 8·53 or 8° 31′, the sine of which is 0·148, or nearly 15 per cent as the grade of the tunnel.

Communications Received.

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